



National Capital Region Network

2008 Forest Vegetation Monitoring Report

Natural Resource Report NPS/NCRN/NRTR—2009/181



ON THE COVER

Forest monitoring in Catoctin Mountain Park.
Photograph by: Thomas Paradis, NPS.

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Executive Summary

This report presents a summary of the forest monitoring data collected in 2008 by the National Capital Region Network Inventory and Monitoring Program. The data collected is used for reporting on three vital signs: forest condition, exotic invasive plant species, and forest pests and diseases. Monitoring was conducted on 100 forest plots randomly located throughout the parks in the National Capital Region Network. This data is part of a long term forest monitoring effort that will include 400 forest plots. One hundred plots are monitored each year, and any particular plot will be monitored once every four years. As this is the first time that this particular set of one hundred plots has been monitored, only status data is available. Trend data will become available once repeat monitoring of the plots begins.

In 2008, monitoring took place in nine of the eleven parks of the network. The data collected includes information on the distribution, abundance and basal area of trees, saplings and seedlings and the quantity of coarse woody debris. Data was also collected on threats to the forest such as insect pests and exotic invasive plant species.

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Introduction

Forests are the predominant natural vegetation in the eleven parks which make up the National Capital Region Network (NCRN, Table 1). Although many of the parks protect cultural and historic resources and provide recreational opportunities, all eleven parks have significant forest resources. In some cases, such as battlefield parks, historic forests are a cultural as well as a natural resource in that they help park visitors understand the historic events that took place in the park.

In 2005, the Inventory and Monitoring program of the NCRN listed 21 priority “vital signs”, which are indicators of the state of natural resources in the NCRN parks (National Park Service 2005). Forest vegetation is one of these vital signs. The focus of this vital sign is to track changes in community composition, such as species composition, growth rates and mortality rates of forest plants.

Two additional vital signs, invasive plant species and forest insect pests and diseases, examine potential threats to forest vegetation and are included in this report. Invasive plant species can crowd out native vegetation and could lead to changes in community composition. Insect pests and diseases can reduce populations of individual plant species.

To address these vital signs, in 2006 the NCRN began a long term forest vegetation monitoring program. The monitoring program consists of taking measurements of forest vegetation on a series of randomly located plots (Schmit et al. 2006, Schmit and Campbell 2007). The plots are modified versions of those used by the Forest Inventory Analysis program of the US Forest Service (Stolte et al. 2002).

This report summarizes the findings of forest vegetation monitoring at the regional and park levels for 2008. This is the third year of forest monitoring, and is the third year in a four year panel. Methods are the same as those used to monitor plots in 2006-7, with some exceptions. The diameter at root crown was measured for all shrubs in 2007 and 2008, as was decided after the 2006 monitoring.

Nine new species were added to the lists of shrubs (see Appendix B). Seven of these species had not been encountered in previous years. Chinkapin (*Castanea pumila*) had been found in 2006 but misidentified as American chestnut (*Castanea dentata*) and monitored as a sapling. Seedlings of chinkapin and silky dogwood (*Cornus amomum*) were found in 2007 and recorded as tree seedlings. Henceforward, these two species will be monitored as shrubs due to the fact that they typically have multiple stems that split at the base of the plants.

Three species were added to the list of exotic understory plants to monitor in 2008 (Appendix C). Although they were already known to be present in the region, they were not encountered on the plots in previous years. Linden arrowwood (*Viburnum dilatatum*) was incorrectly placed on the list of exotic understory plants to monitor in 2006. It has been removed and correctly placed on the list of shrub species. It was not encountered before 2008.

As this is the first time this set of plots have monitored, only status data is presented. Although some results, such as the presence of invasive species, are inherently undesirable, no formal assessment of the state of the parks is made in this report. The second round of sampling of the plots will begin in 2010. At that time the NCRN will be able to begin to evaluate trends in forest communities.

All raw data is available in electronic form directly from the NCRN.

Methods

A summary of the methods use for forest monitoring is provided in this section. For more detailed information consult the NCRN forest monitoring protocol (Schmit et al. 2006).

Forest monitoring plots have been established throughout the eleven parks that make up the NCRN. Plot locations were selected using a randomized design known as “generalized random tessellation stratified” (GRTS; Stevens and Olsen 2004). A GRTS design gives the investigator a spatially balanced (not clumped) and random set of sampling sites. The output of a GRTS draw is an ordered list of potential plot locations. If some of the locations are not suitable they are eliminated and the next locations down the list are chosen instead without the loss of spatial balance or randomness. This is particularly useful in the National Capital Region where current vegetation maps are not available for all parks, and cultural, archeological or other concerns may preclude plot setup on otherwise suitable sites.

In order to choose locations for the forest plots, ArcMap 9.0 (ESRI Inc., Redlands, CA) was used to place a 250m grid over the entire region. Every intersection of the grid was a potential monitoring location. The 250m spacing was chosen as the NCRN will monitor forest birds at these locations, and bird monitoring points should be 250m apart (Dawson 2006). A GRTS draw was performed on this list of potential locations using S-Draw1b (West Inc 2005). As a result of this methodology the number of plots in each park over the 4 year sampling cycle will be approximately proportional to the forest area in each park. Starting in 2005, potential sampling locations were visited and unsuitable sites were eliminated from forest monitoring. In order to find 100 forest plot locations for 2008, 203 locations were considered, of which 103 locations were rejected. Locations were rejected for a variety of reasons including: being found in managed grasslands, roads or other non-forest habitat; being located off of park-owned property, or due to slopes steeper than 30°. After permits were obtained, plots were established at these locations and later measured by the seasonal monitoring crew (Table 1).

Table 1. Location and number of forest monitoring plots in 2008.

Park name	Park abbreviation	Plots monitored	Locations rejected
Antietam National Battlefield	ANTI	0	5
Catoctin Mountain Park	CATO	16	2
Chesapeake and Ohio Canal National Historical Park	CHOH	15 ¹	42
George Washington Memorial Parkway	GWMP	5 ¹	7
Harpers Ferry National Historical Park	HAFE	7	2
Manassas National Battlefield Park	MANA	5	11
Monocacy National Battlefield	MONO	1	5
National Capital Parks-East	NACE	11	19
Prince William Forest Park	PRWI	33	6
Rock Creek Park	ROCR	7	4
Wolf Trap National Park for the Performing Arts	WOTR	0	0

¹One plot located in the Great Falls area on the Maryland side of the Potomac Gorge is on land managed by CHOH but owned by GWMP. Results for this plot are reported under CHOH.

Plot Layout

Each forest monitoring location consists of a 15m radius circular plot with an area of 707 m² (Figure 1). All trees ≥ 10 cm dbh (diameter at breast height, 1.37 m) are identified, the diameter measured at breast height, tagged and mapped in the plot. Trees are marked at breast height with forestry paint so that future measurements will be made at the same location on the tree. Also recorded is the presence of vines on each tree, targeted insect pests and diseases (Appendix A), and other conditions that could increase tree mortality.

Within the main plot are three 3m radius circular microplots, with a combined area of 85m². All saplings (trees between 1 and 10 cm dbh) and shrubs are identified, measured and tagged on these microplots. Saplings are measured at breast height and shrubs are measured at the root crown. Shrubs are woody species that are generally multi-stemmed. In practice, the field crew is provided with a list of species which are to be measured as shrubs (Appendix B).

Three 15m long transects radiate out from the center to the edge of the plot, which are used for measuring coarse woody debris. All woody debris ≥ 7.5 cm diameter and 1 m length is measured and assigned a decay class.

Finally, 12 1m² quadrats (0.5 m x 2 m) are placed in the microplots and along the transects. Cover of select exotic and native herbaceous species (Appendix C) and seeding regeneration is measured in the quadrats.

Forest plot design and measurements are generally based on that of the US Forest Service Forest Inventory and Analysis Program (FIA), but modifications have been made. In general, the total area of the plot is nearly the same as that of the FIA plots (Stolte et al. 2002), but the NCRN plots are more compact. The more compact design was adopted as it is better suited to monitoring very small forest patches, which are often found in NCR parks.

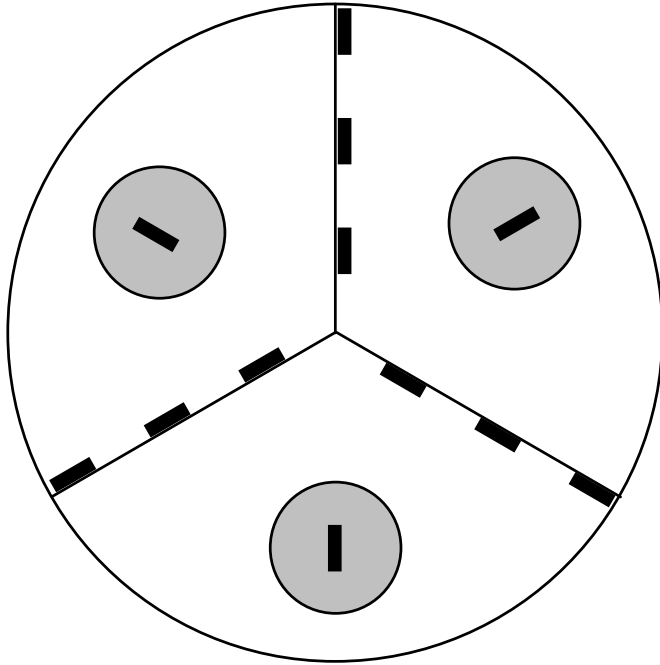


Figure 1. Layout of Forest Monitoring Plots. Trees are monitored within the 15m radius white circle. Saplings and shrubs are monitored within the 3m radius grey circles. Seedlings and select exotic and native herbaceous plants are monitored in the 1m² black quadrats. Coarse woody debris is measured on the 15m long transects emanating from the center of the plot.

Forest Communities in the National Capital Region

Tree Density and Basal Area

During 2008, a total of 2671 individual trees (dbh ≥ 10 cm) were tagged and measured (Table 2). We estimate that once all 400 plots are installed, the NCRN will be monitoring over 10,500 individual trees.

Table 2. Tree density, basal area (BA) and species richness by park.

Park	Plots	Trees	Trees/ha	BA(cm ² /ha)	Species	Species/Plot
CATO	16	344	304	293,000	29	7.4
CHOH	15	392	370	298,000	43	7.5
GWMP	5	171	484	406,000	20	7.0
HAFF	7	180	364	255,000	25	8.3
MANA	5	158	447	171,000	23	5.8
MONO	1	31	439	339,000	7	7.0
NACE	11	299	385	242,000	34	6.4
PRWI	33	930	399	251,000	24	7.5
ROCR	7	166	335	382,000	30	8.3
Total	100	2671	378	278,000	64	7.3

The number of individual trees per plot varied from a high of 92 to a low of 0. The plot with no trees is an open field which is succeeding to forest in Manassas. Tree basal area on individual plots varied from a low of 0 to a high of 51,100 cm²

In total, individuals from 64 tree species were found in the region, with most parks having considerably fewer. The C&O Canal had the largest number of tree species, which is not surprising as many plots were located in the park and the park spans four different ecoregions. However, this year the highest average number of tree species per plot were found in Harpers Ferry and Rock Creek. The number of tree species on individual plots varied from 0 to 12.

Sapling Density and Basal Area

During 2008, a total of 808 saplings (trees between 1 and 10 cm dbh) were tagged and measured (Table 3). We estimate that once all 400 plots are installed, the NCRN will be monitoring over 3200 individual saplings.

In general, fewer saplings are monitored than trees. However, a smaller area is monitored for saplings (85 vs. 707m²), so on a per hectare basis saplings are more dense than trees. The number of saplings on an individual plot varied from six plots with zero to a single plot with 48.

Table 3. Sapling density, basal area (BA) and species richness by park.

Park	Plots	Saplings	Saplings/ha	BA(cm ²)/ ha	Species	Species/Plot
CATO	16	38	280	8480	11	1.4
CHOH	15	156	1230	16,200	17	2.5
GWMP	5	56	1320	18,500	9	2.4
HAFE	7	40	674	12,100	13	3.1
MANA	5	21	495	12,100	8	1.8
MONO	1	6	707	14,700	4	4.0
NACE	11	58	622	11,100	18	2.4
PRWI	33	392	1400	25,900	19	3.9
ROCR	7	41	691	12,400	14	3.0
Total	100	808	953	14,400	42	2.8

Only 42 sapling species were present on the plots as compared to 64 trees species. Fewer individual saplings than trees were monitored, which likely accounts for some of this difference. The highest number of sapling species were three plots with 10, two in PRWI and one in ROCR. PRWI had the largest number of sapling species

Tree Seedling Density

During 2008, 622 seedlings (trees less than 1cm dbh and ≥ 15 cm height) were identified and their heights were measured (Table 4). We did not tag seedlings as this would be practically difficult and we expect them to have a high mortality rate.

Twenty plots had no seedlings, and an additional seven plots had only one. On the other hand, three plots had over 50 seedlings, one of which had 60. There is considerable variation in seedling density across the region, even in relatively well sampled parks. Seedling density was notably low in Catocin.

A total of 41 tree species were found as seedlings on the plots, fewer than were found as mature trees. This is at least partially due to the fact that a smaller area was surveyed for seedlings and fewer individual tree seedlings were found than trees. The highest seedling species richness, 8 species, was found on a plot in Prince William Forest Park.

Table 4. Tree seedling density and richness by park.

Park	Plots	Seedlings	Seedlings/ha	Species	Species/Plot
CATO	16	22	1150	8	0.5
CHOH	15	90	5000	17	2.1
GWMP	5	85	14,100	10	3.2
HAFE	7	46	5480	11	2.7
MANA	5	16	2670	6	1.6
MONO	1	10	8330	5	5.0
NACE	11	48	3640	16	2.5
PRWI	33	280	7070	23	3.0
ROCR	7	25	2980	13	2.6
Total	100	622	5180	41	2.3

Tree Species Diversity

Across the region, 64 species were found as trees, saplings and/or seedlings (Table 5). While many of these species were found in all three growth states, a majority were found in only one or two. For example, Virginia pine (*Pinus virginiana*) is one of the most common species in terms of individual trees. It is nearly absent in the sapling layer, as it only establishes in early successional forests (Burns and Honkala 1990), which were found on few plots. Pawpaw (*Asimina triloba*) is relatively rare as a large tree, but is a common species in both the sapling and seedling layer.

Table 5. Tree species found on the forest monitoring plots.

Latin Name	Common Name	Trees	Tree Basal Area cm ² /ha	Saplings	Sapling BA cm ² /ha	Seedlings
<i>Acer negundo</i>	box elder	68	3040	8	301	11
¹ <i>Acer platanoides</i>	Norway maple	6	103	1	58	-
<i>Acer rubrum</i>	red maple	289	14,300	76	2040	30
<i>Acer saccharinum</i>	silver maple	32	13,100	-	-	1
<i>Acer saccharum</i>	sugar maple	72	3580	14	551	1
¹ <i>Ailanthus altissima</i>	tree of heaven	7	614	2	44	26
<i>Amelanchier arborea</i>	common serviceberry	1	11	3	13	9
<i>Asimina triloba</i>	pawpaw	2	23	160	1130	81
<i>Betula lenta</i>	sweet birch	33	3360	-	-	2
<i>Carpinus caroliniana</i>	American hornbeam	17	437	16	296	24
<i>Carya alba</i>	mockernut	69	2940	22	506	7
	hickory					
<i>Carya cordiformis</i>	bitternut hickory	9	1000	1	20	-
<i>Carya glabra</i>	pignut hickory	67	4050	7	244	7
<i>Carya ovalis</i>	red hickory	2	52	-	-	-
<i>Carya ovata</i>	shagbark hickory	17	1430	1	15	-
<i>Castanea dentata</i>	American chestnut	1	13	1	24	-
<i>Catalpa</i> ¹ <i>Catalpa</i>	southern catalpa	3	116	-	-	-
<i>bignonioides</i>						
<i>Celtis occidentalis</i>	common hackberry	5	121	-	-	2
<i>Cercis canadensis</i>	eastern redbud	9	177	2	88	-
<i>Cornus florida</i>	flowering dogwood	32	560	21	791	1
<i>Diospyros virginiana</i>	common persimmon	2	44	11	180	5
<i>Fagus grandifolia</i>	American beech	215	11,400	175	3890	43
<i>Fraxinus americana</i>	white ash	65	7880	17	307	24
<i>Fraxinus pennsylvanica</i>	green ash	14	2230	1	59	13
<i>Fraxinus profunda</i>	pumpkin ash	88	4260	3	165	11
<i>Gleditsia triacanthos</i>	honeylocust	1	175	-	-	-
<i>Ilex opaca</i>	American holly	10	225	45	904	32
<i>Juglans nigra</i>	black walnut	6	434	-	-	1
<i>Juniperus virginiana</i>	eastern red cedar	109	3940	13	375	4
<i>Liquidambar styraciflua</i>	sweetgum	71	5850	13	235	7
<i>Liriodendron tulipifera</i>	tulip poplar	308	61,100	9	429	3
¹ <i>Maclura pomifera</i>	Osage orange	3	136	-	-	-
<i>Magnolia acuminata</i>	cucumber tree	2	372	-	-	-
¹ <i>Malus prunifolia</i>	plumleaf crabapple	1	14	-	1-	-
¹ <i>Malus sieboldii</i>	toringo crabapple	-	-	1	13	-
¹ <i>Malus</i> spp.	apple	-	-	-	-	1
¹ <i>Morus alba</i>	white mulberry	4	360	3	55	-
<i>Morus rubra</i>	red mulberry	1	12	-	-	-
<i>Nyssa sylvatica</i>	blackgum	147	5830	85	2140	8
<i>Ostrya virginiana</i>	hop hornbeam	8	135	12	490	5
¹ <i>Paulownia tomentosa</i>	princess tree	1	20	-	-	-

Table 5. Tree species found on the forest monitoring plots (continued).

Latin Name	Common Name	Trees	Tree Basal Area cm ² /ha	Saplings	Sapling BA cm ² /ha	Seedlings
<i>Pinus echinata</i>	shortleaf pine	2	165	-	-	-
<i>Pinus rigida</i>	pitch pine	3	416	-	-	-
<i>Pinus strobus</i>	white pine	4	167	-	-	-
<i>Pinus virginiana</i>	Virginia pine	178	17,400	1	40	4
<i>Platanus occidentalis</i>	American sycamore	24	5110	2	35	1
<i>Populus deltoides</i>	eastern cottonwood	29	2570	-	-	-
¹ <i>Prunus avium</i>	sweet cherry	6	328	2	32	1
<i>Prunus serotina</i>	black cherry	53	4430	6	184	15
¹ <i>Pyrus calleryana</i>	Callery pear	-	-	1	2	-
¹ <i>Pyrus</i> spp.	pear	14	543	-	-	-
<i>Quercus alba</i>	white oak	153	28,400	36	323	140
<i>Quercus coccinea</i>	scarlet oak	46	8590	-	-	33
<i>Quercus falcata</i>	southern red oak	28	4390	3	47	2
<i>Quercus palustris</i>	pin oak	6	1330	-	-	5
<i>Quercus phellos</i>	willow oak	7	1480	-	-	4
<i>Quercus prinus</i>	chestnut oak	83	14,700	2	104	11
<i>Quercus rubra</i>	northern red oak	61	16,500	3	25	3
<i>Quercus stellata</i>	post oak	3	164	-	-	-
<i>Quercus velutina</i>	black oak	47	10,900	2	52	9
<i>Quercus X bushii</i>	Bush's oak	1	29	-	-	1
<i>Quercus</i> spp.	oak	1	38	1	21	-
<i>Rhus copallina</i>	shining sumac	-	-	-	-	3
<i>Robinia pseudoacacia</i>	black locust	44	2840	2	81	3
<i>Sassafras albidum</i>	sassafras	22	713	9	288	21
<i>Tilia americana</i>	American basswood	9	865	-	-	-
<i>Tsuga canadensis</i>	eastern hemlock	1	172	-	-	-
<i>Ulmus americana</i>	American elm	49	2350	15	381	11

¹Non-native species.

Shrub Density

During 2008, a total of 693 individuals from 18 shrub species (typically multi-stemmed with a diameter at root crown ≥ 1 cm [Appendix B]) were tagged and measured on the microplots in each plot (Table 6). We estimate that once all 400 plots are installed, the NCRN will be monitoring over 2000 shrubs. Some species that are commonly considered shrubs, such as multi-flora rose (*Rosa multiflora*) often grow as a dense cover that makes it difficult to delineate individual plants. These species are monitored by measuring their cover on the quadrats, as it is impractical to tag and measure individuals. Shrubs are much less common than trees; 53 plots did not contain any shrubs.

Shrub richness per plot is considerably lower than that of trees. Only four plots contained more than two shrub species.

Table 6. Shrub density and species richness by park.

Park	Plots	Shrubs	Shrubs per ha	BA(cm ²)/ha	Species	Species/ Plot
CATO	16	188	1380	77,000	3	0.4
CHOH	15	69	542	26,000	4	0.4
GWMP	5	66	1560	88,800	8	2.2
HAFE	7	19	320	20,700	1	0.1
MANA	5	15	354	17,100	3	0.8
MONO	1	-	-	-	-	-
NACE	11	19	204	37,800	5	0.5
PRWI	33	257	918	50,400	5	0.8
ROCR	7	60	1010	64,800	5	1.0
Total	100	693	817	48,300	18	0.7

Shrub Seedling Density

A total of 394 shrub seedlings were found across all of the plots, far fewer than the number of tree seedlings found (Table 7). Only 43 plots had shrub seedlings present.

Shrub seedling density varied greatly across parks. ROCR had much higher densities than the other parks, where as CHOH had very few.

Twenty different shrubs were present as seedlings (Table 8).

Table 7. Shrub seedling density and species richness by park.

Park	Plots	Seedlings	Seedlings/ha	Species	Species/Plot
CATO	16	85	4430	1	0.4
CHOH	15	16	889	5	0.6
GWMP	5	40	6670	8	2.4
HAFE	7	45	5360	5	0.7
MANA	5	39	6500	6	1.4
MONO	1	-	-	-	-
NACE	11	22	1670	4	0.6
PRWI	33	51	1290	4	0.3
ROCR	7	96	11,400	6	2.0
Total	100	394	3280	21	0.7

Shrub Species Diversity

Two shrub species, northern spicebush (*Lindera benzoin*) and mountain laurel (*Kalmia latifolia*) make up over 80% of individual shrubs (Table 8). These two species also accounted for over 60% of all shrub seedlings. The other native species are relatively uncommon across the region.

Table 8. Shrub species found on the forest monitoring plots.

Latin Name	Common Name	Shrubs	Seedlings
<i>Alnus serrulata</i>	hazel alder	3	1
<i>Castanea pumila</i>	chinkapin	1	-
<i>Cornus amomum</i>	silky dogwood	2	3
¹ <i>Elaeagnus umbellata</i>	autumn olive	20	27
¹ <i>Euonymus alatus</i>	burning bush	-	6
<i>Euonymus americanus</i>	strawberry bush	-	2
<i>Euonymus atropurpureus</i>	wahoo	-	1
<i>Hamamelis virginiana</i>	American witchhazel	2	2
<i>Ilex verticillata</i>	common winterberry	1	4
<i>Kalmia latifolia</i>	mountain laurel	219	45
¹ <i>Ligustrum ovalifolium</i>	California privet	3	-
¹ <i>Ligustrum vulgare</i>	European privet	4	-
<i>Lindera benzoin</i>	northern spicebush	363	193
¹ <i>Lonicera maackii</i>	Amur honeysuckle	2	5
¹ <i>Lonicera morrowii</i>	Morrow's honeysuckle	-	6
<i>Lyonia ligustrina</i>	maleberry	6	3
<i>Rhododendron periclymenoides</i>	pinxter flower	-	1
<i>Rhus copallina</i>	shining sumac	-	3
<i>Rosa carolina</i>	Carolina rose	-	3
<i>Sambucus canadensis</i>	American black elderberry	-	1
<i>Vaccinium corymbosum</i>	highbush blueberry	2	-
<i>Vaccinium fuscum</i>	black highbush blueberry	33	-
<i>Viburnum acerifolium</i>	mapleleaf viburnum	-	44
<i>Viburnum dentatum</i>	southern arrow wood	12	7
¹ <i>Viburnum dilatatum</i>	linden arrowwood	3	15
¹ <i>Viburnum plicatum</i>	Japanese snowball	4	-
<i>Viburnum prunifolium</i>	blackhaw	13	22

¹Non-native species.

Coarse Woody Debris

Coarse woody debris (CWD) was measured using the line-intersect method (Van Wagner 1968) on three 15 m long transects in each plot. On average, there were 76.4 m³ per ha of CWD ≥ 7.5 cm diameter across all plots (Table 9). The large volume of coarse woody debris in George Washington Memorial Parkway is in part due to a single black oak (*Quercus velutina*) log that is over 2 meters in diameter. This log is in plot GWMP-0139 in the Turkey Run section of the park.

Table 9. Mean coarse woody debris by park.

Park Code	Plots	Coarse woody debris m ³ /ha
CATO	16	66.50
CHOH	15	53.40
GWMP	5	304.00
HAFE	7	30.10
MANA	5	23.90
MONO	1	3.95
NACE	11	37.70
PRWI	33	95.60
ROCR	7	46.40
Total	100	76.40

Forest Pests and Diseases in the National Capital Region

Forest pests and diseases were selected as one of the 21 vital signs for the parks in NCRN. Forests in the parks have historically been impacted by pests such as the gypsy moth (*Lymantria dispar*), and diseases such as the chestnut blight. Trees on forest monitoring plots were monitored for a select group of pests and diseases (Appendix A). The list will be reviewed annually for appropriate additions or removals. Two new pests were added to the list in 2008: dogwood anthracnose (*Discula* sp.) and elongate hemlock scale (*Fiorinia externa*).

In 2008, gypsy moths were the only pest species encountered. They were found on 118 trees, which is 4.4% of all monitored trees. Catoctin had 82 infected trees, more than any other park. Other parks with gypsy moth include the C&O canal (6 trees), Harpers Ferry (27 trees), Manassas (2 trees) and Monocacy (1 tree). Catoctin and Harpers Ferry were both treated for gypsy moth early in 2008. Egg cases that were in the treatment area were counted as proof of gypsy moth infestation, even if the treatment may preclude any of the eggs surviving to adulthood. Therefore, the effects of the treatment will not be apparent in the monitoring data until the 2009 field season.

Several tree species were impacted by gypsy moth. These include; 41 trees of chestnut oak (*Quercus prinus*); 22 trees of northern red oak (*Quercus rubra*); 10 trees of red maple (*Acer rubrum*) and American beech (*Fagus grandifolia*); 6 trees of sweet birch (*Betula lenta*) and white oak (*Quercus alba*); 4 trees of blackgum (*Nyssa sylvatica*); 3 trees of sugar maple (*Acer saccharum*) and black oak (*Quercus velutina*); 2 trees of shagbark hickory (*Carya ovata*), tulip poplar (*Liriodendron tulipifera*) and American basswood (*Tilia americana*) and one tree each of silver maple (*Acer saccharinum*), pignut hickory (*Carya glabra*), flowering dogwood (*Cornus florida*), white ash (*Fraxinus americana*), sweet cherry (*Prunus avium*), and scarlet oak (*Quercus coccinea*).

Exotic Plant Species in the National Capital Region

Many exotic plant species are found in the parks that make up the NCRN. Exotic plant species can exclude native species, may be less suitable for wildlife, and may have negative impacts on other aspects of the ecosystem such as soil quality.

The NCRN is measuring distribution and abundance of exotic plant species using the forest monitoring plots. Exotic trees, vines, shrubs and select herbaceous plants are monitored.

Exotic Tree Species

Of the 64 species found as trees, ten are not native to the region (Table 5). Combined these species are represented by 45 individual trees, which make up 1.7% of all trees and 0.8% of all tree basal area.

Six species found as saplings are not native to the region. Combined these species are represented by only ten individuals which make up 1.2% of all saplings and 1.2% of all sapling basal area.

Seedlings of two exotic species, tree of heaven (*Ailanthus altissima*) and apple (*Malus* spp.), were found. Twenty-seven individual seedlings were found, which represents 4.3% of all seedlings.

Based on the data collected in 2008, exotic tree species are present throughout the region but they represent a localized problem and are not currently a broad threat to forest communities.

Vines in Trees

The NCRN does not tag and monitor individual vines. However, vines are identified when they grow on tagged trees. Vines are noted and identified regardless of whether they are native, exotic, invasive, or non-invasive. Additionally, exotic vines which occur as cover on the quadrats are also monitored (see below).

In all, 718 trees, 26.8% of all marked trees, had vines growing on them (Table 10). Of these, 341 (12.8%) had vines growing in the crown of the tree. Vines that grow in the crowns of trees could increase tree mortality by shading leaves or toppling trees due to the increased weight. Vines in trees are particularly common in some parks, such as CHOH and NACE where forest edge is more common.

Table 10. Presence of vines in trees by park.

Park	Plots	Trees	Trees with Vines	Tree with vines in crown
CATO	16	344	37	29
CHOH	15	392	173	99
GWMP	5	171	56	6
HAFE	7	180	81	45
MANA	5	158	101	80
MONO	1	31	-	-
NACE	11	299	156	59
PRWI	33	930	52	8
ROCR	7	166	60	15
Total	100	2671	716	341

Of the 16 species or genera of vines found, ten were exotic species (Table 11). In total, 302 trees had exotic vines growing on them and of these, 178 had exotic vines growing in the crown of the tree. Native species, including poison ivy (*Toxicodendron radicans*), Virginia creeper (*Parthenocissus quinquefolia*) and wild grape (*Vitis* spp.) were also very common.

Table 11. Species of vines in trees.

Latin Name	Common Name	Trees with Vines	Tree with vines in crown
¹ <i>Ampelopsis brevipedunculata</i>	porcelainberry	13	10
<i>Campsis radicans</i>	trumpet creeper	17	1
¹ <i>Celastrus orbiculatus</i>	Oriental bittersweet	25	20
¹ <i>Clematis terniflora</i>	sweet autumn clematis	2	-
¹ <i>Euonymus fortunei</i>	winter creeper	2	2
¹ <i>Hedera helix</i>	English ivy	81	30
¹ <i>Lonicera japonica</i>	Japanese honeysuckle	144	91
<i>Parthenocissus quinquefolia</i>	Virginia creeper	142	66
¹ <i>Polygonum perfoliatum</i>	mile-a-minute	4	-
¹ <i>Pueraria montana</i>	kudzu	14	12
¹ <i>Rosa multiflora</i>	multiflora rose	16	12
<i>Smilax</i> spp.	greenbrier	114	17
<i>Toxicodendron radicans</i>	poison ivy	195	59
<i>Vitis</i> spp.	grape	306	257
¹ <i>Wisteria sinensis</i>	Chinese wisteria	1	1

¹Non-native species.

Not all tree species were equally impacted by vines (Table 12). For twenty-eight tree species, over 10% of all individual trees have vines in their crowns.

Table 12. Tree species affected by vines.

Tree Species	Trees	Trees with Vines	Trees with Vines in Crown
<i>Acer negundo</i>	68	31	21
¹ <i>Acer platanoides</i>	6	3	1
<i>Acer rubrum</i>	289	60	22
<i>Acer saccharinum</i>	32	20	6
<i>Acer saccharum</i>	72	15	7
¹ <i>Ailanthus altissima</i>	7	5	4
<i>Amelanchier arborea</i>	1	1	1
<i>Betula lenta</i>	33	1	-
<i>Carpinus caroliniana</i>	17	3	3
<i>Carya alba</i>	69	10	7
<i>Carya cordiformis</i>	9	4	3
<i>Carya glabra</i>	67	5	3
¹ <i>Catalpa bignonioides</i>	3	2	1
<i>Celtis occidentalis</i>	5	4	4
<i>Cercis canadensis</i>	9	7	4
<i>Cornus florida</i>	32	6	3
<i>Diospyros virginiana</i>	2	1	-
<i>Fagus grandifolia</i>	215	19	6
<i>Fraxinus americana</i>	65	27	14
<i>Fraxinus pennsylvanica</i>	14	11	9
<i>Fraxinus profunda</i>	88	40	2
<i>Gleditsia triacanthos</i>	1	1	-
<i>Ilex opaca</i>	10	2	1
<i>Juglans nigra</i>	6	3	-
<i>Juniperus virginiana</i>	109	86	68
<i>Liquidambar styraciflua</i>	71	40	10
<i>Liriodendron tulipifera</i>	308	51	20
¹ <i>Maclura pomifera</i>	3	3	1
¹ <i>Morus alba</i>	4	4	4
<i>Nyssa sylvatica</i>	147	19	13
<i>Pinus rigida</i>	3	2	-
<i>Pinus strobus</i>	4	2	2
<i>Pinus virginiana</i>	178	31	2
<i>Platanus occidentalis</i>	24	14	4
<i>Populus deltoides</i>	5	5	1
¹ <i>Prunus avium</i>	6	3	3
<i>Prunus serotina</i>	53	41	25
¹ <i>Pyrus</i> spp.	14	14	12
<i>Quercus alba</i>	153	9	1
<i>Quercus coccinea</i>	46	4	-
<i>Quercus falcata</i>	28	1	1
<i>Quercus palustris</i>	6	4	1
<i>Quercus phellos</i>	7	2	1
<i>Quercus prinus</i>	83	10	3
<i>Quercus rubra</i>	61	4	1
<i>Quercus velutina</i>	47	9	2
<i>Quercus</i> spp.	1	1	-
<i>Robinia pseudoacacia</i>	44	39	24
<i>Sassafras albidum</i>	22	14	7
<i>Tsuga canadensis</i>	1	1	-
<i>Ulmus americana</i>	49	22	13

¹Non-native species.

Exotic Shrubs

Of the twenty-seven shrub species found (Table 8), eight are exotic. Only one exotic shrub species had more than four individual shrubs. Autumn olive (*Elaeagnus umbellata*) was represented by 20 individual shrubs in two plots, one in Manassas and the other along the C&O canal. In total, 36 exotic shrubs and 59 exotic shrub seedlings were found. These represent 5.2 % of all individual shrubs, and 14.9% of all shrub seedlings.

Exotic Herbaceous Plants

On each plot, 12 quadrats measuring 0.5×2m are surveyed for targeted exotic plants. These include herbaceous exotics as well as some vines and shrubs such as multi-flora rose (*Rosa multiflora*) which cannot practically be monitored by tagging individual plants. Of the 100 plots monitored in 2008, 65 had invasive species on at least 1 quadrat (Table 13). No park was free from such species. The percent of plots with herbaceous exotics varies considerably between parks, but only in Prince William Park was this less than 50%.

Table 13. Frequency of exotic herbaceous plants by park.

Park	Plots	Plots with exotic herbs	% of plots with exotic herbs	Quadrats with exotics per plot with exotics
CATO	16	13	81%	8.8
CHOH	15	15	100%	10.4
GWMP	5	5	100%	5.6
HAFE	7	4	57%	9.0
MANA	5	4	80%	9.5
MONO	1	1	100%	11.0
NACE	11	10	91%	9.0
PRWI	33	7	21%	5.0
ROCR	7	6	86%	10.0
Total	100	65	65%	8.7

Twenty-one exotic plant species were detected on the quadrats (Table 14). While most of the species were not widespread, several are found on a large number of plots throughout the region. The most common species include garlic mustard (*Alliaria petiolata*) and Japanese stiltgrass (*Microstegium vimineum*) which are herbaceous species, and Japanese honeysuckle (*Lonicera japonica*) which can grow either as a shrub or a climbing vine. Two species, Japanese stiltgrass and English ivy (*Hedera helix*) had a high % cover on the plots they invaded.

Table 14. Cover of exotic plants.

Latin name	Common name	Plots	Mean % cover when present
<i>Akebia quinata</i>	chocolate vine	1	<1%
<i>Alliaria petiolata</i>	garlic mustard	37	2%
<i>Ampelopsis brevipedunculata</i>	porcelainberry	9	<1%
<i>Berberis thunbergii</i>	Japanese barberry	12	5%
<i>Celastrus orbiculatus</i>	Oriental bittersweet	18	2%
<i>Duchesnea indica</i>	Indian strawberry	13	<1%
<i>Euonymus fortunei</i>	winter creeper	1	<1%
<i>Glechoma hederacea</i>	ground ivy	7	10%
<i>Hedera helix</i>	English Ivy	7	25%
<i>Lespedeza cuneata</i>	Chinese lespedeza	1	5%
<i>Lonicera japonica</i>	Japanese honeysuckle	39	4%
<i>Lonicera</i> spp.	honeysuckle	11	<1%
<i>Lysimachia nummularia</i>	creeping jenny	3	10%
<i>Microstegium vimineum</i>	Japanese stiltgrass	38	20%
<i>Polygonum caespitosum</i>	Oriental ladythumb	16	1%
<i>Polygonum cuspidatum</i>	Japanese knotweed	1	6%
<i>Polygonum perfoliatum</i>	mile-a-minute	5	2%
<i>Pueraria montana</i>	kudzu	1	13%
<i>Rosa multiflora</i>	multiflora rose	11	2%
<i>Rubus phoenicolasius</i>	wineberry	12	1%
<i>Wisteria sinensis</i>	Chinese wisteria	2	<1%

Catoctin Mountain Park

Sixteen plots were monitored in Catoctin in 2008 (Figure 3).

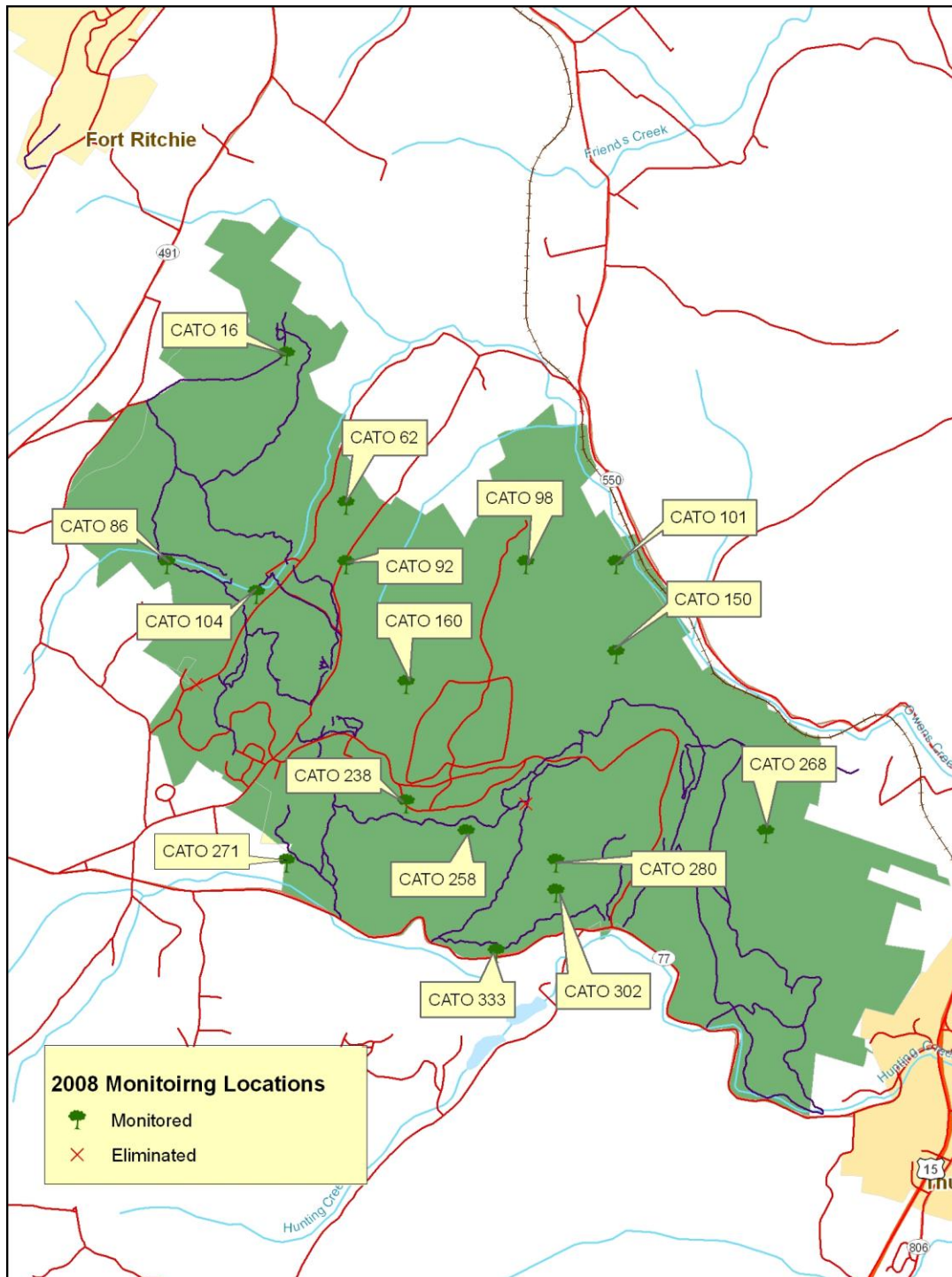


Figure 2. Locations considered for forest monitoring in Catoctin.

Forest Communities

There is considerable variation in tree and sapling density and basal area among plots in Catoctin (Table 15). There were no saplings in the microplots on two of the plots.

Only 22 seedlings were found in Catoctin. Seedling density is less than one-fourth that of the region as a whole. On the quadrats of thirteen plots, no seedlings were found.

Table 15. Density, basal area (BA) and species richness of trees, saplings and seedlings in Catoctin.

Plot	Trees	Trees/ha	Tree BA(cm ²)/ha	Tree Species	Saplings	Saplings /ha	Sapling BA(cm ²)/ha	Sapling Species	Seedlings	Seedlings /ha	Seedling Species
CATO-0016	24	340	339,000	9	1	118	2240	1	-	-	-
CATO-0062	8	113	216,000	5	1	118	4160	1	-	-	-
CATO-0086	25	354	327,000	7	2	236	9900	1	-	-	-
CATO-0092	10	141	105,000	7	4	472	19,600	1	5	4170	4
CATO-0098	25	354	255,000	8	1	118	2040	1	-	-	-
CATO-0101	20	283	489,000	7	2	236	11,600	2	-	-	-
CATO-0104	15	212	255,000	8	10	1180	29,000	4	3	2500	2
CATO-0150	22	311	258,000	5	4	472	10,200	1	-	-	-
CATO-0160	35	495	386,000	8	2	236	6500	2	-	-	-
CATO-0238	31	439	365,000	10	2	236	6500	2	-	-	-
CATO-0258	19	269	191,000	10	-	-	-	-	-	-	-
CATO-0268	23	325	285,000	5	1	118	1130	1	-	-	-
CATO-0271	23	325	268,000	4	-	-	-	-	14	11,700	2
CATO-0280	20	283	270,000	8	2	236	566	1	-	-	-
CATO-0302	26	368	441,000	9	4	472	23,500	2	-	-	-
CATO-0333	18	255	243,000	8	2	236	8740	2	-	-	-
Total	344	304	293,000	29	38	280	8480	11	22	1150	8

In total, 31 tree species were found in Catoctin (Table 16).

Table 16. Tree species found in Catoctin.

Latin Name	Common Name	Trees	Tree BA cm ² /ha	Trees with vines/in crown	Saplings	Sapling BA cm ² /ha	Seedlings
<i>Acer rubrum</i>	red maple	42	12,500	6/5	3	641	1
<i>Acer saccharinum</i>	silver maple	1	90	-/-	-	-	-
<i>Acer saccharum</i>	sugar maple	50	17,200	4/4	9	2190	-
¹ <i>Ailanthus</i>	tree of heaven	1	77	-/-	-	-	13
<i>altissima</i>							
<i>Amelanchier</i>	common	1	69	1/1	-	-	-
<i>arborea</i>	serviceberry						
<i>Asimina triloba</i>	pawpaw	-	-	-/-	2	37	-
<i>Betula lenta</i>	sweet birch	31	19,500	-/-	-	-	2
<i>Carpinus</i>	American	3	263	-/-	6	884	-
<i>caroliniana</i>	hornbeam						
<i>Carya alba</i>	mockernut	1	92	-/-	3	943	-
	hickory						
<i>Carya cordiformis</i>	bitternut hickory	2	237	-/-	1	125	-
<i>Carya glabra</i>	pignut hickory	8	1160	2/2	-	-	-
<i>Carya ovalis</i>	red hickory	2	328	-/-	-	-	-
<i>Carya ovata</i>	shagbark hickory	16	8600	-/-	1	96	-
<i>Castanea dentata</i>	American	1	81	-/-	1	147	-
	chestnut						
<i>Celtis occidentalis</i>	common	1	243	-/-	-	-	-
	hackberry						
<i>Cornus florida</i>	flowering	2	184	-/-	2	398	-
	dogwood						
<i>Fagus grandifolia</i>	American beech	21	11,400	3/3	3	833	1
<i>Fraxinus</i>	white ash	32	38,300	9/5	-	-	2
<i>americana</i>							
<i>Liriodendron</i>	tuliptree	24	49,600	2/2	-	-	1
<i>tulipifera</i>							
<i>Magnolia</i>	cucumber tree	2	2320	-/-	-	-	-
<i>acuminata</i>							
<i>Nyssa sylvatica</i>	blackgum	9	4740	3/3	-	-	-
<i>Ostrya virginiana</i>	hop hornbeam	6	630	-/-	7	2200	1
¹ <i>Prunus avium</i>	sweet cherry	3	626	-/-	-	-	-
<i>Prunus serotina</i>	black cherry	3	335	1/-	-	-	-
<i>Quercus alba</i>	white oak	6	9770	-/-	-	-	-
<i>Quercus prinus</i>	chestnut oak	35	42,500	2/1	-	-	-
<i>Quercus rubra</i>	northern red oak	30	58,400	2/1	-	-	-
<i>Quercus velutina</i>	black oak	3	8980	1/1	-	-	-
<i>Sassafras albidum</i>	sassafras	-	-	-/-	-	-	1
<i>Tilia americana</i>	American	7	5060	-/-	-	-	-
	basswood						
<i>Ulmus americana</i>	American elm	1	201	1/1	-	-	-

¹Non-native species.

Shrubs were found on only six plots (Table 17). With the exception of the lone shrub on plot CATO-0258, shrubs were found only in the northwest portion of the park.

Table 17. Density, basal area, seedling density and species richness of shrubs in Catoctin.

Plot	Shrubs	Shrubs per ha	Species	BA (cm ²)/ha	Seedlings	Seedlings/ha
CATO-0016	16	1890	1	168,000	23	19,200
CATO-0062	99	11,700	1	669,000	40	33,300
CATO-0086	27	3180	1	60,500	7	5830
CATO-0092	37	4360	1	265,000	10	8330
CATO-0098	-	-	-	-	-	-
CATO-0101	-	-	-	-	-	-
CATO-0104	8	943	2	64,700	4	3330
CATO-0150	-	-	-	-	-	-
CATO-0160	-	-	-	-	-	-
CATO-0238	-	-	-	-	-	-
CATO-0258	1	118	1	4960	-	-
CATO-0268	-	-	-	-	-	-
CATO-0271	-	-	-	-	1	833
CATO-0280	-	-	-	-	-	-
CATO-0302	-	-	-	-	-	-
CATO-0333	-	-	-	-	-	-
Total	188	1380	3	77,000	85	4430

Three species of shrub were found, all of which are native (Table 18).

Table 18. Shrub species found in Catoctin.

Latin Name	Common Name	Shrubs	Seedlings
<i>Hamamelis virginiana</i>	American witchhazel	1	-
<i>Lindera benzoin</i>	northern spicebush	186	85
<i>Viburnum prunifolium</i>	blackhaw	1	-

Forest Pests and Diseases

In Catoctin, gypsy moths were found on 82 trees, which is 23.8% of all trees monitored. These were found throughout the park in plots CATO-0086, -0092, -0098, -0150, -0160, -0238, -0268, -0271, -0280, -0302, and -0333.

Trees which were impacted include 28 trees of chestnut oak (*Quercus prinus*); 16 trees of northern red oak (*Quercus rubra*); 8 trees of American beech (*Fagus grandifolia*); 6 trees of (*Betula lenta*); 4 trees of red maple (*Acer rubrum*) and white oak (*Quercus alba*); 3 trees of sugar maple (*Acer saccharum*), and blackgum (*Nyssa sylvatica*); 2 trees of shagbark hickory (*Carya ovata*) and American basswood (*Tilia americana*) and one tree each of silver maple (*Acer saccharinum*), flowering dogwood (*Cornus florida*), white ash (*Fraxinus americana*), tulip poplar (*Liriodendron tulipifera*), sweet cherry (*Prunus avium*), and black oak (*Quercus velutina*).

Exotic Plant Species

Exotic Trees

Two exotic tree species were found in Catoctin. A single tree of heaven (*Ailanthus altissima*) was found in plot CATO-0098 in the north central portion of the park. Thirteen tree of heaven seedlings occurred in plot CATO-0271, a blow-down area in the southwestern corner of the park. Tree of heaven accounted for more than half of all tree seedlings found on the plots.

Three trees of sweet cherry (*Prunus avium*) were found. Two were in plot CATO-0016 in the north west of the park and one was in plot CATO-0280 in the south central portion of the park.

Exotic Vines

Only 10.8% of trees had vines on them, compared to 26.8% in the region as a whole. Only 8.4% of trees had vines in the crown, compared to only 12.8% of trees in the region as a whole

Table 19. Presence of vines in Catoctin.

Plot	Trees	Trees with Vines	Trees with Vines in Crown
CATO-0016	24	10	5
CATO-0062	8	-	-
CATO-0086	25	-	-
CATO-0092	10	-	-
CATO-0098	25	5	4
CATO-0101	20	-	-
CATO-0104	15	-	-
CATO-0150	22	-	-
CATO-0160	35	1	-
CATO-0238	31	-	-
CATO-0258	19	7	7
CATO-0268	23	-	-
CATO-0271	23	5	5
CATO-0280	20	6	5
CATO-0302	26	3	3
CATO-0333	18	-	-
Total	344	37	29

Four native vines were found growing on trees in Catoctin. Wild grape (*Vitis* spp.) was the most common, found on 29 trees. No exotic vine species were found on trees in 2008.

Table 20. Species of vines in trees in Catoctin.

Latin Name	Common Name	Trees with Vines	Tree with vines in crown
<i>Parthenocissus quinquefolia</i>	Virginia creeper	4	-
<i>Smilax</i> spp.	greenbrier	1	-
<i>Toxicodendron radicans</i>	poison ivy	4	2
<i>Vitis</i> spp.	grape	29	28

Exotic Shrubs

No exotic species monitored as shrubs were found in Catoctin. However, we did find two exotic species with a shrub like growth that are monitored as herbaceous species (Table 22), Japanese barberry (*Berberis thunbergii*) and wineberry (*Rubus phoenicolasius*).

Exotic Herbaceous Species

Thirteen of the sixteen plots monitored had exotic herbaceous species (Table 21). In total, 59% of the quadrats had exotic plants in Catoctin, as compared to 47% in the region as a whole.

Table 21. Presence of exotic herbaceous plants in Catoctin.

Plot	Quadrats with Exotics	Number of Exotic Species
CATO-0016	9	4
CATO-0062	12	4
CATO-0086	11	2
CATO-0092	12	5
CATO-0098	11	4
CATO-0101	12	3
CATO-0104	8	3
CATO-0150	6	1
CATO-0160	-	-
CATO-0238	-	-
CATO-0258	6	1
CATO-0268	-	-
CATO-0271	11	4
CATO-0280	12	2
CATO-0302	1	1
CATO-0333	3	1
Total		7

Seven exotic species were found on the plots. Garlic mustard (*Alliaria petiolata*), Japanese barberry (*Berberis thunbergii*) and Japanese stiltgrass (*Microstegium vimineum*) were the most common (Table 22).

Table 22. Cover of exotic plants in Catoctin.

Latin name	Common name	Plots	Mean % cover when present
<i>Alliaria petiolata</i>	garlic mustard	8	2%
<i>Berberis thunbergii</i>	Japanese barberry	7	5%
<i>Lonicera japonica</i>	Japanese honeysuckle	1	<1%
<i>Microstegium vimineum</i>	Japanese stiltgrass	12	19%
<i>Polygonum caespitosum</i>	Oriental ladythumb	4	2%
<i>Polygonum perfoliatum</i>	mile-a-minute	1	1%
<i>Rubus phoenicolasius</i>	wineberry	2	1%

Chesapeake and Ohio Canal National Historical Park

Fifteen plots were monitored along the C&O Canal in 2008. The plots were located along the length of the canal (Figure 3).

Forest Communities

There is considerable variation in all measures relating to trees across the plots (Table 31).

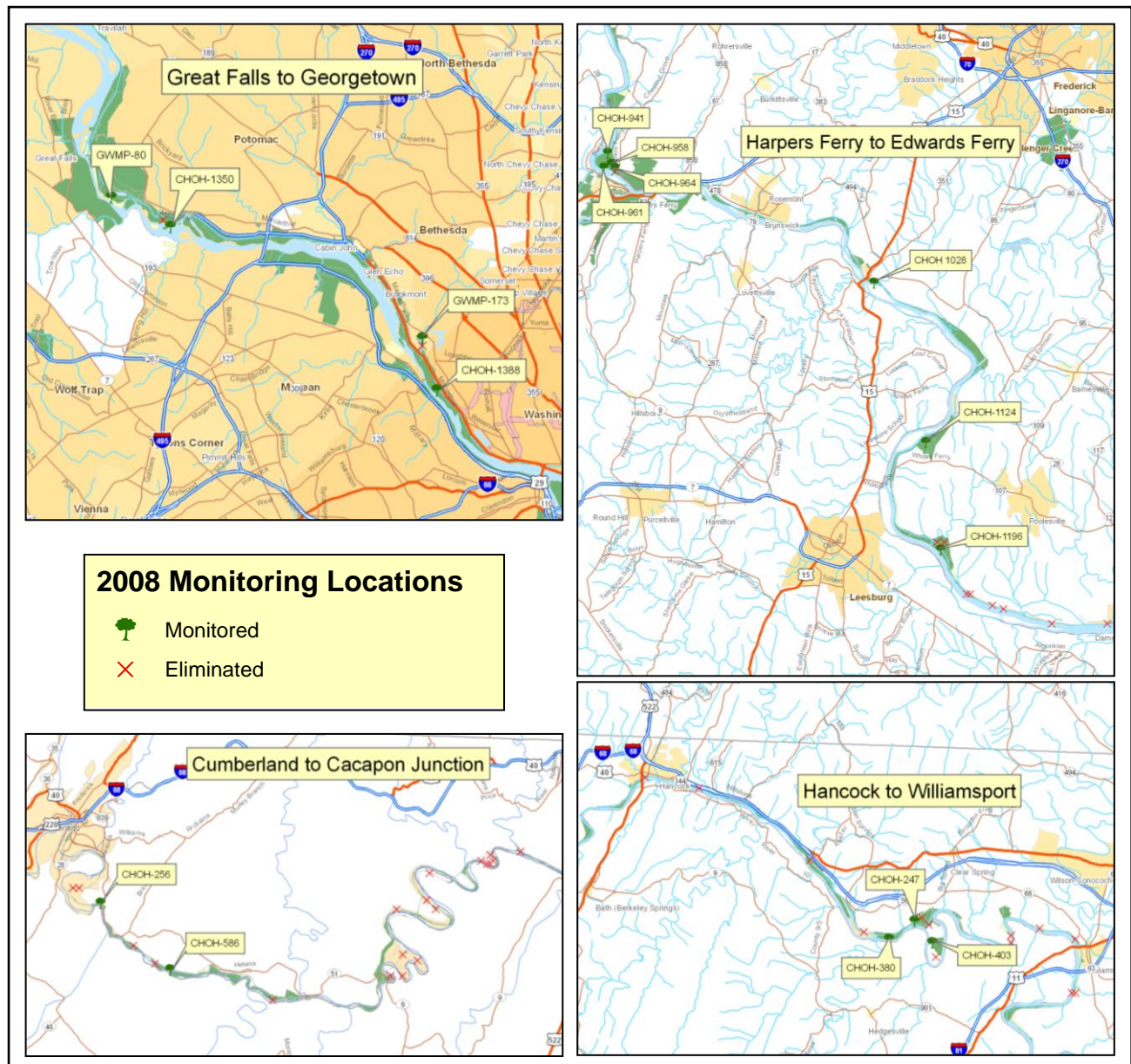


Figure 3. Locations considered for forest monitoring along the C&O Canal.

Table 23. Density, basal area (BA) and richness of trees, saplings and seedlings on the C&O Canal.

Plot	Trees	Trees/ha	Tree BA(cm ²)/ha	Tree Species	Saplings	Saplings/ ha	Sapling BA(cm ²)/ha	Sapling Species	Seedlings	Seedlings/ ha	Species
CHOH-0247	46	651	217,000	7	9	1060	21,500	4	5	4170	5
CHOH-0256	20	283	342,000	6	1	118	1010	1	2	1670	1
CHOH-0380	28	396	535,000	4	6	707	11,500	3	-	-	-
CHOH-0403	22	311	246,000	6	2	236	9410	2	4	3330	3
CHOH-0586	28	396	170,000	9	2	236	7440	2	2	1670	2
CHOH-0941	19	269	310,000	9	11	1300	21,200	3	20	16,700	2
CHOH-0958	23	325	569,000	12	5	589	8100	2	3	2500	2
CHOH-0961	25	354	197,000	8	5	589	8040	2	8	6670	2
CHOH-0964	30	424	157,000	10	16	1890	25,700	2	1	833	1
CHOH-1028	13	184	723,000	3	8	943	14,500	2	5	4170	3
CHOH-1124	17	241	387,000	4	26	3060	11,900	3	17	14,200	1
CHOH-1196	37	523	173,000	11	3	354	18,500	1	7	5830	3
CHOH-1350	35	495	143,000	6	10	1180	21,300	5	11	9170	5
CHOH-1388	16	226	133,000	5	48	5660	48,600	2	5	4170	2
GWMP-0080	33	467	179,000	12	4	472	15,100	4	-	-	-
Total	392	370	299,000	43	156	1230	16,250	17	90	5000	17

Forty three different tree species were found along the C&O Canal (Table 24).

Table 24. Tree species found along the C&O Canal.

Latin Name	Common Name	Trees	Tree BA cm ² /ha	Trees with vines/in crown	Saplings	Sapling BA cm ² /ha	Seedlings
<i>Acer negundo</i>	box elder	41	10,600	12/7	6	1540	1
¹ <i>Acer platanoides</i>	Norway maple	1	133	-	-	-	-
<i>Acer rubrum</i>	red maple	9	4450	1/-	4	896	-
<i>Acer saccharinum</i>	silver maple	31	87,200	20/6	-	-	1
<i>Acer saccharum</i>	sugar maple	2	231	-	2	1120	-
¹ <i>Ailanthus altissima</i>	tree of heaven	4	3400	3/3	-	-	12
<i>Asimina triloba</i>	pawpaw	1	77	-	106	4940	44
<i>Carpinus caroliniana</i>	America hornbeam	2	564	-	1	8	-
<i>Carya alba</i>	mockernut	17	3640	-	3	141	-
<i>Carya cordiformis</i>	hickory	1	1415	-	-	-	-
	bitternut						
<i>Carya glabra</i>	pignut hickory	11	3060	1/-	2	157	1
¹ <i>Catalpa bignonioides</i>	southern catalpa	1	399	-	-	-	-
<i>Celtis occidentalis</i>	common hackberry	1	167	1/1	-	-	1
<i>Cercis canadensis</i>	eastern redbud	3	469	2/-	-	-	-
<i>Cornus florida</i>	flowering dogwood	1	77	1/1	1	464	-
<i>Diospyros virginiana</i>	common persimmon	1	188	-	1	299	1
<i>Fagus grandifolia</i>	American beech	2	283	-	1	479	-
<i>Fraxinus americana</i>	white ash	8	1820	6/3	8	1300	3
<i>Fraxinus pennsylvanica</i>	green ash	9	9590	7/6	-	-	8
<i>Gleditsia triacanthos</i>	honey locust	1	1170	1/-	-	-	-
<i>Juglans nigra</i>	black walnut	4	961	2/-	-	-	1
<i>Juniperus virginiana</i>	eastern red cedar	31	10,300	24/17	-	-	1
<i>Liriodendron tulipifera</i>	tulip poplar	43	53,600	12/8	2	700	-
¹ <i>Maclura pomifera</i>	Osage orange	3	904	3/1	-	-	-
¹ <i>Morus alba</i>	white mulberry	1	396	1/1	-	-	-
<i>Nyssa sylvatica</i>	blackgum	5	1400	-	-	-	-
<i>Ostrya virginiana</i>	hop hornbeam	2	231	-	5	927	4
<i>Pinus virginiana</i>	Virginia pine	4	2610	-	-	-	-
<i>Platanus occidentalis</i>	American sycamore	10	8730	5/-	-	-	1
¹ <i>Prunus avium</i>	sweet cherry	1	846	1/1	-	-	-

Table 24. Tree species found along the C&O Canal (continued).

Latin Name	Common Name	Trees	Tree BA cm ² /ha	Trees with vines/in crown	Saplings	Sapling BA cm ² /ha	Seedlings
<i>Prunus serotina</i>	black cherry	34	19,500	27/18	2	574	1
¹ <i>Pyrus</i> spp.	pear	13	2390	13/11	-	-	-
<i>Quercus alba</i>	white oak	5	8320	-	-	-	-
<i>Quercus coccinea</i>	scarlet oak	2	3880	-	-	-	-
<i>Quercus palustris</i>	pin oak	3	2730	3/1	-	-	-
<i>Quercus prinus</i>	chestnut oak	19	13,600	-	-	-	-
<i>Quercus rubra</i>	northern red oak	10	18,400	-	2	157	-
<i>Quercus stellata</i>	post oak	2	253	-	-	-	-
<i>Quercus velutina</i>	black oak	2	6310	-	-	-	-
<i>Robinia pseudoacacia</i>	black locust	18	4900	14/8	2	542	1
<i>Sassafras albidum</i>	sassafras	4	1430	3/2	-	-	2
<i>Tilia americana</i>	American basswood	1	137	-	-	-	-
<i>Ulmus americana</i>	American elm	28	8040	10/4	8	1970	7

¹Non-native species.

Shrubs were found at only five plots and seedlings at six plots at scattered locations along the canal (Table 25).

Table 25. Density, basal area, seedling density and species richness of shrubs along the C&O Canal.

Plot	Shrubs	Shrubs per ha	Species	BA(cm ²)/ha	Seedlings	Seedling/ha
CHOH-0247	12	1415	1	42,700	11	9170
CHOH-0256	44	5187	1	274,000	1	833
CHOH-0380	1	118	1	4280	1	833
CHOH-0403	4	472	1	15,600	-	-
CHOH-0586	-	-	-	-	-	-
CHOH-0941	-	-	-	-	-	-
CHOH-0958	-	-	-	-	-	-
CHOH-0961	-	-	-	-	1	833
CHOH-0964	-	-	-	-	-	-
CHOH-1028	-	-	-	-	-	-
CHOH-1124	8	943	2	53,700	-	-
CHOH-1196	-	-	-	-	1	833
CHOH-1350	-	-	-	-	-	-
CHOH-1388	-	-	-	-	1	833
GWMP-0080	-	-	-	-	-	-
Total	69	542	4	26,000	16	888

Seven shrub species were found along the canal, but two were found only as seedlings. Northern spicebush (*Lindera benzoin*) was the most common shrub (Table 26).

Table 26. Shrub species found along the C&O Canal.

Latin Name	Common Name	Shrubs	Seedlings
¹ <i>Elaeagnus umbellata</i>	autumn olive	12	5
<i>Euonymus atropurpureus</i>	wahoo	-	1
<i>Hamamelis virginiana</i>	American witchhazel	1	-
¹ <i>Ligustrum vulgare</i>	European privet	4	-
<i>Lindera benzoin</i>	northern spicebush	52	4
¹ <i>Lonicera morrowii</i>	Morrow's honeysuckle	-	4
<i>Viburnum prunifolium</i>	blackhaw	-	2

¹Non-native species.

Forest Pests and Diseases

Gypsy moth was found in six trees along the C&O Canal. Four of them were in plot CHOH-958 near Harpers Ferry, and two in plot CHOH-1350 near Great Falls, Maryland.

Exotic Plant Species

Exotic Trees

Seven exotic tree species are found along the canal (Table 24). They make up 6.1% of all individuals and 2.8% of all basal area in the tree layer, are absent from the sapling layer, and are 13.3% of all seedlings. Four tree species were affected. These include 2 trees each of chestnut oak (*Quercus prinus*) and northern red oak (*Quercus rubra*); and one tree each of pignut hickory (*Carya glabra*) and scarlet oak (*Quercus coccinea*).

Vines in Trees

Vines in trees are common along the C&O Canal (Table 27). Vines were especially common on plot CHOH-0247 at four locks and CHOH-0964 Harpers Ferry.

Table 27. Presence of vines along the C&O Canal.

Plot	Trees	Trees with Vines	Trees with Vines in Crown
CHOH-0247	46	41	29
CHOH-0256	20	17	5
CHOH-0380	28	6	2
CHOH-0403	22	14	9
CHOH-0586	28	7	-
CHOH-0941	19	-	-
CHOH-0958	23	-	-
CHOH-0961	25	9	1
CHOH-0964	30	29	26
CHOH-1028	13	9	5
CHOH-1124	17	1	1
CHOH-1196	37	26	9
CHOH-1350	35	1	-
CHOH-1388	16	13	12
GWMP-0080	33	-	-
Total	392	173	99

Most vines growing in trees along the Canal are native species (Table 28). However, numerous exotic vines, from five exotic species were also found. Japanese honeysuckle (*Lonicera japonica*) was the most common exotic vine.

Table 28. Species of vines in trees along the C&O Canal.

Latin Name	Common Name	Trees with Vines	Tree with vines in crown
<i>Campsis radicans</i>	trumpet creeper	3	1
¹ <i>Celastrus orbiculatus</i>	Oriental bittersweet	6	5
¹ <i>Lonicera japonica</i>	Japanese honeysuckle	32	16
<i>Parthenocissus quinquefolia</i>	Virginia creeper	66	26
¹ <i>Polygonum perfoliatum</i>	mile-a-minute	4	-
¹ <i>Rosa multiflora</i>	multiflora rose	9	6
<i>Smilax</i> spp.	greenbrier	2	1
<i>Toxicodendron radicans</i>	poison ivy	26	15
<i>Vitis</i> spp.	grape	108	88
¹ <i>Wisteria sinensis</i>	Chinese wisteria	1	1

¹ Non-native species.

Exotic Shrubs

Of the seven shrub species found (Table 26), three are exotic. The most common exotic shrub was autumn olive (*Elaeagnus umbellata*) which was found at CHOH-0247 at four locks. In total, 16 exotic shrubs and 9 exotic shrub seedlings were found. Together these represent 23.2% of all individual shrubs, and 56.2% of all shrub seedlings.

Exotic Herbaceous Plants

Exotic herbaceous plants are very common along the C&O Canal. All plots, and 86% of all quadrats monitored, had exotic plants growing on them (Table 29).

Table 29. Presence of exotic herbaceous plants along the C&O Canal.

Plot	Quadrats with Exotics	Number of Exotic Species
CHOH-0247	12	5
CHOH-0256	12	4
CHOH-0380	12	8
CHOH-0403	12	6
CHOH-0586	12	6
CHOH-0941	12	1
CHOH-0958	6	2
CHOH-0961	10	4
CHOH-0964	12	5
CHOH-1028	11	4
CHOH-1124	11	2
CHOH-1196	12	5
CHOH-1350	7	5
CHOH-1388	12	9
GWMP-0080	3	3
Total		14

Fourteen species of exotic herbaceous plants were found along the canal (Table 30).

Table 30. Cover of exotic plants along the C&O Canal.

Latin name	Common name	Plots	Mean % cover when present
<i>Alliaria petiolata</i>	garlic mustard	12	4%
<i>Berberis thunbergii</i>	Japanese barberry	3	9%
<i>Celastrus orbiculatus</i>	Oriental bittersweet	3	1%
<i>Duchesnea indica</i>	Indian strawberry	5	2%
<i>Glechoma hederacea</i>	ground ivy	4	14%
<i>Lonicera japonica</i>	Japanese honeysuckle	10	5%
<i>Lonicera</i> spp.	honeysuckle	2	<1%
<i>Lysimachia nummularia</i>	creeping jenny	3	11%
<i>Microstegium vimineum</i>	Japanese stiltgrass	10	31%
<i>Polygonum caespitosum</i>	Oriental ladythumb	4	<1%
<i>Polygonum perfoliatum</i>	mile-a-minute	2	1%
<i>Rosa multiflora</i>	multiflora rose	7	2%
<i>Rubus phoenicolasius</i>	wineberry	3	2%
<i>Wisteria sinensis</i>	Chinese wisteria	1	<1%

George Washington Memorial Parkway

Five plots were monitored along the George Washington Memorial Parkway (GWMP) in 2008.

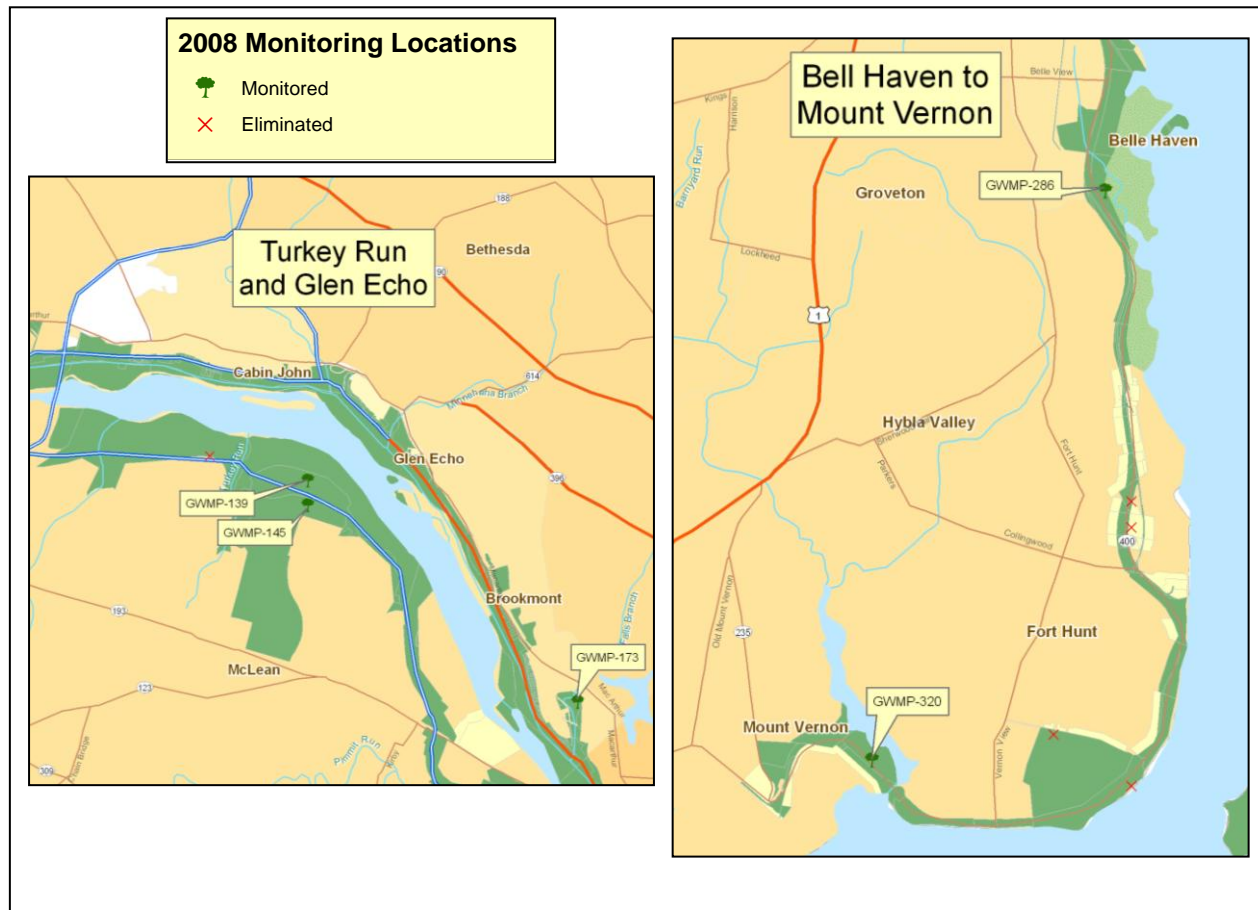


Figure 4. Locations considered for forest monitoring in George Washington Memorial Parkway.

Forest Communities

Density and basal area information for the five plots is presented in Table 31. In total, 24 tree species were found (Table 32).

Table 31. Density, basal area (BA) and richness of trees, saplings and seedlings in GWMP.

Plot	Trees	Trees/ha	Tree BA(cm ²)/ha	Tree Species	Saplings	Saplings/ha	Sapling BA(cm ²)/ha	Sapling Species	Seedlings	Seedlings/ha	Species
GWMP-0138	20	283	514,000	8	34	4010	22,600	2	7	5830	2
GWMP-0145	22	311	328,000	5	7	825	14,400	1	4	3330	3
GWMP-0173	18	255	313,000	8	5	589	13,300	3	4	3330	4
GWMP-0286	92	1300	477,000	7	7	825	36,000	3	12	10,000	2
GWMP-0320	19	269	399,000	7	3	354	6060	3	58	48,300	5
Total	171	484	406,000	20	56	1320	18,500	9	85	14,200	10

Table 32. Tree species found in GWMP.

Latin Name	Common Name	Trees	Tree BA cm ² /ha	Trees with vines/in crown	Saplings	Sapling BA cm ² /ha	Seedlings
<i>Acer negundo</i>	box elder	-	-	-	-	-	1
<i>Acer rubrum</i>	red maple	15	8030	7/-	4	4030	1
<i>Amelanchier arborea</i>	common serviceberry	-	-	-	1	118	-
<i>Asimina triloba</i>	pawpaw	-	-	-	33	4340	20
<i>Betula lenta</i>	sweet birch	1	3320	-	-	-	-
<i>Carya alba</i>	mockernut	5	8180	-	1	401	-
	hickory						
<i>Carya glabra</i>	pignut hickory	3	2310	-	-	-	-
<i>Cercis canadensis</i>	eastern redbud	1	274	-	-	-	-
<i>Cornus florida</i>	flowering dogwood	1	337	-	-	-	-
<i>Diospyros virginiana</i>	common persimmon	-	-	-	2	1340	-
<i>Fagus grandifolia</i>	American beech	7	5750	-	10	3770	-
<i>Fraxinus americana</i>	white ash	3	863	-	1	118	6
<i>Fraxinus pennsylvanica</i>	green ash	3	4880	2/2	-	-	-
<i>Fraxinus profunda</i>	pumpkin ash	63	47,200	29/2	3	3300	11
<i>Liquidambar styraciflua</i>	sweetgum	4	3080	4/-	-	-	-
<i>Liriodendron tulipifera</i>	tulip poplar	38	194,000	8/1	1	1010	1
<i>Morus rubra</i>	red mulberry	1	235	-	-	-	-
<i>Nyssa sylvatica</i>	blackgum	3	4630	2/1	-	-	-
<i>Platanus occidentalis</i>	American sycamore	6	9420	4/-	-	-	-
<i>Prunus serotina</i>	black cherry	2	498	-	-	-	5
<i>Quercus alba</i>	white oak	6	47,600	-	-	-	38
<i>Quercus coccinea</i>	scarlet oak	1	1830	-	-	-	-
<i>Quercus rubra</i>	northern red oak	3	21,800	-	-	-	1
<i>Quercus velutina</i>	black oak	5	41,900	-	-	-	1

Shrubs were found in four of the GWMP plots monitored in 2008 (Table 33).

Table 33. Density, basal area, seedling density and species richness of shrubs in GWMP.

Plot	Shrubs	Shrubs per ha	Species	BA(cm ²)/ha	Seedlings	Seedlings/ha
GWMP-0139	12	1420	1	126,000	13	10,800
GWMP-0145	22	2590	2	62,000	16	13,300
GWMP-0173	-	-	-	-	-	-
GWMP-0286	29	3420	7	250,000	11	9170
GWMP-0320	3	354	1	5820	-	-
Total	66	1560	8	88,800	40	6670

Ten shrub species were found (Table 34), the most common of which was northern spicebush (*Lindera benzoin*)

Table 34. Shrub species found in GWMP.

Latin Name	Common Name	Shrubs	Seedlings
<i>Alnus serrulata</i>	hazel alder	3	1
<i>Cornus amomum</i>	silky dogwood	2	3
¹ <i>Euonymus alatus</i>	burning bush	-	2
<i>Ilex verticillata</i>	common winterberry	1	-
¹ <i>Ligustrum ovalifolium</i>	California privet	3	-
<i>Lindera benzoin</i>	northern spicebush	36	22
<i>Sambucus canadensis</i>	American black elderberry	-	1
<i>Viburnum dentatum</i>	southern arrowwood	11	3
¹ <i>Viburnum dilatatum</i>	Linden arrowwood	2	5
<i>Viburnum prunifolium</i>	blackhaw	8	3

¹Non-native species.

Forest Pests and Diseases.

No forest pest or diseases were found on the plots in 2008.

Exotic Plant Species

Exotic Trees

No exotic trees were found on the plots monitored in 2008.

Vines in Trees

Vines in trees were rare, except for plot GWMP-0286, located in the swamplands near Dyke Marsh (Table 35).

Table 35. Presence of vines in GWMP.

Plot	Trees	Trees with Vines	Trees with Vines in Crown
GWMP-0139	20	1	1
GWMP-0145	22	-	-
GWMP-0173	18	-	-
GWMP-0286	92	53	5
GWMP-0320	19	2	-
Total	171	56	6

All but two of the vines found on trees were native species, with poison ivy (*Toxicodendron radicans*) the most common (Table 36). Few vines reached the crowns of the trees, none of which were exotic.

Table 36. Species of vines in trees in GWMP.

Latin Name	Common Name	Trees with Vines	Tree with vines in crown
<i>Campsis radicans</i>	trumpet creeper	12	-
¹ <i>Celastrus orbiculatus</i>	Oriental bittersweet	1	-
¹ <i>Lonicera japonica</i>	Japanese honeysuckle	1	-
<i>Parthenocissus quinquefolia</i>	Virginia creeper	11	3
<i>Smilax</i> spp.	greenbrier	5	-
<i>Toxicodendron radicans</i>	eastern poison ivy	47	4
<i>Vitis</i> spp.	grape	6	2

¹ Non-native species.

Exotic Shrubs

Of the ten shrub species found (Table 34), three are exotic. None of the exotic shrubs were particularly abundant. In total, 5 exotic shrubs and 7exotic shrub seedlings were found. Together these represent 7.6% of all individual shrubs, and 17.5% of all shrub seedlings.

Exotic Herbaceous Species

Exotic herbaceous plants were found on all five plots (Table 37).

Table 37. Presence of exotic herbaceous plants in GWMP.

Plot	Quadrats with Exotics	Number of Exotic Species
GWMP-0139	7	3
GWMP-0145	9	8
GWMP-0173	7	6
GWMP-0286	1	1
GWMP-0320	4	2
Total		11

Although there were numerous exotic herbaceous species present, none of them had a mean cover greater than 2% (Table 38). Japanese stiltgrass (*Microstegium vimineum*) and Japanese honeysuckle (*Lonicera japonica*) were found in the most plots.

Table 38. Cover of exotic plants in GWMP.

Latin name	Common name	Plots	Mean % cover when
<i>Akebia quinata</i>	chocolate vine	1	<1%
<i>Alliaria petiolata</i>	garlic mustard	2	<1%
<i>Ampelopsis brevipedunculata</i>	porcelainberry	2	<1%
<i>Celastrus orbiculatus</i>	Oriental bittersweet	3	2%
<i>Duchesnea indica</i>	Indian strawberry	1	<1%
<i>Glechoma hederacea</i>	ground ivy	1	<1%
<i>Hedera helix</i>	English ivy	1	1%
<i>Lonicera japonica</i>	Japanese honeysuckle	4	<1%
<i>Lonicera</i> spp.	honeysuckle	3	<1%
<i>Microstegium vimineum</i>	Japanese stiltgrass	1	<1%
<i>Rubus phoenicolasius</i>	wineberry	1	<1%

Harpers Ferry National Historical Park

Seven plots were monitored in Harper's Ferry in 2008 (Figure 5).

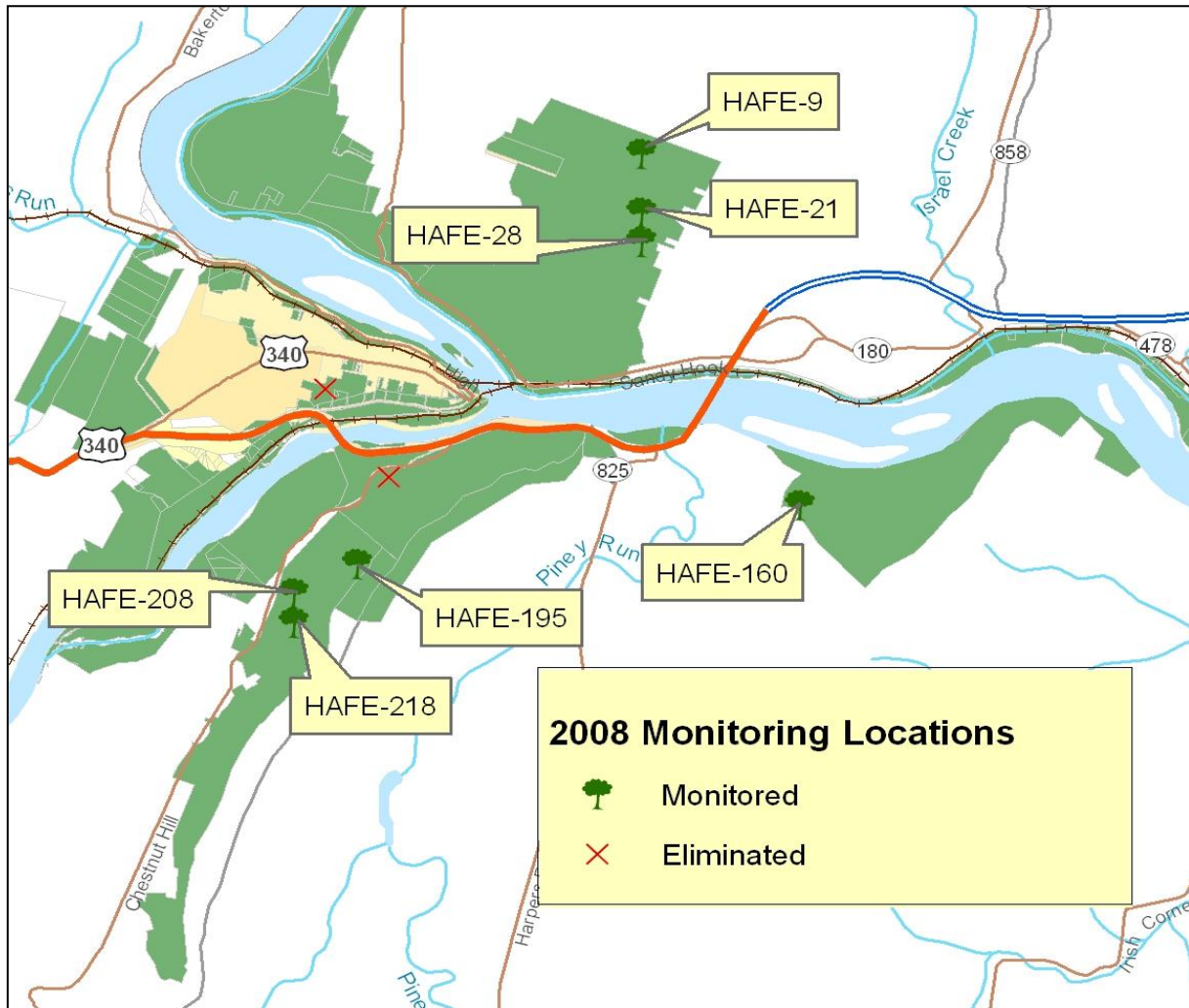


Figure 5. Locations considered for forest monitoring in Harpers Ferry.

Forest Communities

Density and basal area information for the seven plots is presented in Table 39. In total, 31 tree species were found in the plots (Table 40).

Table 39. Density, basal area (BA) and richness of trees, saplings and seedlings in Harpers Ferry.

Plot	Trees	Trees/ ha	Tree BA(cm ²)/ha	Tree Species	Saplings	Saplings/ha	Sapling BA(cm ²)/ha	Sapling Species	Seedlings	Seedlings/ha	Species
HAFE-0009	25	354	178,000	9	5	589	9780	4	-	-	-
HAFE-0021	37	523	313,000	10	9	1060	39,900	6	4	3330	3
HAFE-0028	25	354	199,000	9	-	-	-	-	-	-	-
HAFE-0160	17	241	309,000	6	1	118	1070	1	8	6670	6
HAFE-0195	20	283	161,000	9	10	1180	4640	3	19	15,800	3
HAFE-0208	31	439	320,000	10	8	943	14,000	5	2	1670	2
HAFE-0218	25	354	301,000	5	7	825	15,000	3	13	10,800	5
Total	180	364	255,000	25	40	674	12,100	13	46	5480	42

Table 40. Tree species found in Harpers Ferry.

Latin Name	Common Name	Trees	Tree BA cm ² /ha	Trees with vines/in crown	Saplings	Sapling BA cm ² /ha	Seedlings
<i>Acer negundo</i>	box elder	2	1600	-	-	-	2
¹ <i>Acer</i> <i>platanooides</i>	Norway maple	2	378	1/1	-	-	-
<i>Acer rubrum</i>	red maple	50	36,900	20/11	12	1400	17
<i>Acer saccharum</i>	sugar maple	5	4290	1/1	-	-	-
¹ <i>Ailanthus</i> <i>altissima</i>	tree of heaven	-	-	-	1	438	1
<i>Amelanchier</i> <i>arborea</i>	common serviceberry	-	-	-	-	-	3
<i>Asimina triloba</i>	pawpaw	-	-	-	5	657	5
<i>Betula lenta</i>	sweet birch	1	899	1/-	-	-	-
<i>Carya alba</i>	mockernut	12	6360	8/7	-	-	-
<i>Carya</i> <i>cordiformis</i>	hickory bitternut	5	6990	3/2	-	-	-
<i>Carya glabra</i>	hickory	4	911	1/1	1	876	-
<i>Carya ovata</i>	pignut hickory	1	754	-	-	-	-
<i>Cercis</i> <i>canadensis</i>	shagbark hickory	1	202	1/1	1	67	-
<i>Cornus florida</i>	eastern redbud	-	-	-	1	404	-
<i>Fagus</i> <i>grandifolia</i>	flowering dogwood	5	2110	3/-	2	1100	-
<i>Fraxinus</i> <i>americana</i>	American beech	5	4760	2/-	-	-	1
<i>Juglans nigra</i>	white ash	1	513	1/-	-	-	-
<i>Liriodendron</i> <i>tulipifera</i>	black walnut	9	10,900	3/3	4	2340	-
<i>Nyssa sylvatica</i>	tulip poplar	20	11,200	9/8	6	1840	-
¹ <i>Paulownia</i> <i>tomentosa</i>	blackgum	1	285	-	-	-	-
<i>Platanus</i> <i>occidentalis</i>	princess tree	5	32,500	4/4	-	-	-
¹ <i>Prunus avium</i>	American sycamore	-	-	-	1	17	-
<i>Prunus serotina</i>	sweet cherry	1	497	1/1	-	-	-
<i>Quercus alba</i>	black cherry	6	20,000	2/-	-	-	-
<i>Quercus</i> <i>coccinea</i>	white oak	3	4470	1/-	-	-	-
<i>Quercus prinus</i>	scarlet oak	19	54,400	8/2	2	1480	10
<i>Quercus rubra</i>	chestnut oak	4	12,000	2/-	-	-	-
<i>Quercus velutina</i>	northern red oak	11	39,800	6/1	-	-	2
<i>Robinia</i> <i>pseudoacacia</i>	black oak	-	-	-	-	-	1
<i>Sassafras</i> <i>albidum</i>	black locust	5	1440	3/2	3	1310	3
<i>Ulmus</i> <i>americana</i>	sassafras	2	459	-	1	152	1

¹Non-native species.

Shrubs were not found in most of the plots (Table 41).

Table 41. Density, basal area, seedling density and species richness of shrubs in Harper's Ferry.

Plot	Shrubs	Shrubs / ha	Species	BA(cm ²)/ha	Seedlings	Seedlings/ha
HAFE-0009	-	-	-	-	-	-
HAFE-0021	-	-	-	-	-	-
HAFE-0028	-	-	-	-	-	-
HAFE-0160	19	2240	1	145,000	28	23,300
HAFE-0195	-	-	-	-	15	12,500
HAFE-0208	-	-	-	-	-	-
HAFE-0218	-	-	-	-	2	1670
Total	19	320	1	20,700	45	5360

Northern spicebush (*Lindera benzoin*) was the only species found as a shrub, but five species were found as seedlings (Table 42).

Table 42. Shrub species found in Harpers Ferry.

Latin Name	Common Name	Shrubs	Seedlings
<i>Hamamelis virginiana</i>	American witchhazel	-	2
<i>Lindera benzoin</i>	northern spicebush	19	28
<i>Rhododendron periclymenoides</i>	pinxter flower	-	1
<i>Viburnum acerifolium</i>	mapleleaf viburnum	-	6
<i>Viburnum prunifolium</i>	blackhaw	-	8

Forest Pests and Diseases

In Harpers Ferry, gypsy moths were found on 27 trees, which is 7.4% of all trees monitored. These were found throughout the park in plots HAFE-0009, -0021, -0028, -0098, -195 and -208

Trees which were impacted include 11 trees of chestnut oak (*Quercus prinus*); 6 trees of red maple (*Acer rubrum*); 4 trees of northern red oak (*Quercus rubra*); 2 trees of scarlet oak (*Quercus coccinea*) and one tree each of American beech (*Fagus grandifolia*), white oak (*Quercus alba*), tulip poplar (*Liriodendron tulipifera*) and black oak (*Quercus velutina*).

Exotic Plant Species

Exotic Trees

Four exotic tree species were found (Table 40). They make up 1.7% of all individuals and 0.3% of all basal area in the tree layer, 5% of individuals and 3.7% of basal area in the sapling layer and 2.2% of seedlings.

Vines on Trees

Many vines were found on trees in 2008, and one fourth of all trees had vines in their crowns (Table 43).

Table 43. Presence of vines in Harpers Ferry.

Plot	Trees	Trees with Vines	Trees with Vines in Crown
HAFE-0009	25	17	14
HAFE-0021	37	18	14
HAFE-0028	25	16	10
HAFE-0160	17	6	5
HAFE-0195	20	11	1
HAFE-0208	31	5	-
HAFE-0218	25	8	1
Total	180	81	45

All but one vine monitored in Harpers Ferry were native (Table 44).

Table 44. Species of vines in trees in Harpers Ferry.

Latin Name	Common Name	Trees with Vines	Tree with Vines in Crown
¹ <i>Lonicera japonica</i>	Japanese honeysuckle	1	1
<i>Parthenocissus quinquefolia</i>	Virginia creeper	5	2
<i>Smilax</i> spp.	greenbrier	7	1
<i>Toxicodendron radicans</i>	poison ivy	22	3
<i>Vitis</i> spp.	grape	54	42

¹Non-native species.

Exotic Shrubs

All shrubs found in the monitoring plots were native (Table 42).

Exotic Herbaceous Plants

Exotic herbaceous species were found on four of the seven plots in Harpers Ferry (Table 45).

Table 45. Presence of exotic herbaceous plants in Harpers Ferry.

Plot	Quadrats with Exotics	Number of Exotic Species
HAFE-0009	12	3
HAFE-0021	2	1
HAFE-0028	11	4
HAFE-0160	11	5
HAFE-0195	-	-
HAFE-0208	-	-
HAFE-0218	-	-
Total		7

Seven species of exotic herbaceous species were found in the park (Table 46). Garlic mustard (*Alliaria petiolata*) was the most widespread, whereas Japanese stiltgrass (*Microstegium vimineum*) had the highest percent cover in plots where it was found.

Table 46. Cover of exotic plants in Harpers Ferry.

Latin name	Common name	Plots	Mean % cover when present
<i>Alliaria petiolata</i>	garlic mustard	4	3%
<i>Celastrus orbiculatus</i>	Oriental bittersweet	1	<1%
<i>Glechoma hederacea</i>	ground ivy	1	<1%
<i>Lonicera japonica</i>	Japanese honeysuckle	1	4%
<i>Microstegium vimineum</i>	Japanese stiltgrass	2	11%
<i>Polygonum caespitosum</i>	Oriental ladythumb	2	<1%
<i>Rubus phoenicolasius</i>	wineberry	2	<1%

Manassas National Battlefield Park

Five forest vegetation plots were monitored in Manassas in 2008 (Figure 6).



Figure 6. Locations considered for forest monitoring in Manassas.

Forest Communities

Tree density varied considerably on the plots monitored in Manassas (Table 47). One plot, MANA-131 in the northwest of the park had no trees on it in 2008. This plot is in an area that was formerly used for agriculture but is currently reverting to forest. Twenty-five tree species were found on the plots (Table 48). Eastern red cedar (*Juniperus virginiana*) was the most common tree species. Almost all of the trees of this species were found on plot MANA-218 in the southeast corner of the park.

Table 47. Density, basal area (BA) and richness of trees, saplings and seedlings in Manassas.

Plot	Trees	Trees/ ha	Tree BA(cm ²)/ha	Tree Species	Saplings	Saplings/ha	Sapling BA(cm ²)/ha	Sapling Species	Seedlings	Seedlings/ha	Species
MANA-0011	20	283	164,000	7	1	118	5930	1	5	4170	3
MANA-0131	-	-	-	-	8	943	6790	1	5	4170	2
MANA-0205	32	453	236,000	9	6	707	22,000	4	-	-	-
MANA-0218	77	1090	235,000	4	3	354	12,600	1	1	833	1
MANA-0240	29	410	223,000	9	3	354	13,300	2	5	4170	2
Total	158	447	1712,000	23	21	495	12,100	8	16	2670	6

Table 48. Tree species found on the forest monitoring plots in Manassas.

Latin Name	Common Name	Trees	Tree BA cm ² /ha	Trees with vines/in canopy	Saplings	Sapling BA cm ² /ha	Seedlings
<i>Acer negundo</i>	box elder	12	14,000	10/9	-	-	4
<i>Acer rubrum</i>	red maple	2	1500	1/1	1	472	-
<i>Carya alba</i>	mockernut	7	5860	-	-	-	-
	hickory						
<i>Carya cordiformis</i>	bitternut	1	5230	1/1	-	-	-
	hickory						
<i>Carya glabra</i>	pignut hickory	8	4860	-	1	637	-
<i>Celtis occidentalis</i>	common	3	1130	3/3	-	-	-
	hackberry						
<i>Cercis canadensis</i>	eastern redbud	4	1580	4/3	1	1670	-
<i>Cornus florida</i>	flowering	3	1130	2/1	-	-	-
	dogwood						
<i>Diospyros</i>	common	1	308	1/-	8	1370	4
<i>virginiana</i>	persimmon						
<i>Fraxinus</i>	white ash	8	6550	7/5	2	990	1
<i>americana</i>							
<i>Fraxinus</i>	green ash	-	-	-	1	1180	2
<i>pennsylvanica</i>							
<i>Juglans nigra</i>	black walnut	1	5080	-	-	-	-
<i>Juniperus</i>	eastern red	77	47,400	61/50	6	5020	-
<i>virginiana</i>	cedar						
<i>Liriodendron</i>	tulip poplar	3	15,700	3/2	-	-	-
<i>tulipifera</i>							
<i>Nyssa sylvatica</i>	blackgum	3	2080	-	1	755	-
<i>Pinus strobus</i>	white pine	2	2370	-	-	-	-
<i>Pinus virginiana</i>	Virginia pine	6	11,000	3/2	-	-	-
<i>Prunus serotina</i>	black cherry	1	713	1/-	-	-	-
<i>Quercus alba</i>	white oak	3	13,100	-	-	-	-
<i>Quercus falcata</i>	southern red	1	3740	1/1	-	-	-
	oak						
<i>Quercus palustris</i>	pin oak	1	10,100	1/-	-	-	-
<i>Quercus rubra</i>	northern red	2	1670	-	-	-	-
	oak						
<i>Quercus velutina</i>	black oak	4	13,300	-	-	-	-
<i>Sassafras albidum</i>	sassafras	-	-	-	-	-	3
<i>Ulmus americana</i>	American elm	5	3210	2/2	-	-	2

Shrubs or shrub seedlings were found in four of the five Manassas plots (Table 49).

Table 49. Density, basal area, seedling density and species richness of shrubs in Manassas.

Plot	Shrubs	Shrubs/ ha	Species	BA(cm ²)/ha	Seedlings	Seedlings/ha
MANA-0011	2	236	1	36,1000	3	2500
MANA-0131	-	-	-	-	6	5000
MANA-0205	-	-	-	-	-	-
MANA-0218	8	943	1	7970	27	22500
MANA-0240	5	589	2	41,500	3	2500
Total	15	354	3	17,100	39	6500

Six shrub species were encountered (Table 50). The most common species was autumn olive (*Elaeagnus umbellata*).

Table 50. Shrub species found in Manassas.

Latin Name	Common Name	Shrubs	Seedlings
¹ <i>Eleagnus umbellata</i>	autumn olive	8	22
<i>Lindera benzoin</i>	northern spicebush	6	6
¹ <i>Lonicera morrowii</i>	Morrow's honeysuckle	-	2
<i>Rhus copallina</i>	shining sumac	-	3
<i>Rosa carolina</i>	Carolina rose	-	3
<i>Viburnum prunifolium</i>	blackhaw	1	3

¹Non-native species.

Forest Pest and Diseases

Gypsy moth was found on two trees in Manassas in plot MANA-205 in the south of the park. The trees infested were one blackgum (*Nyssa sylvatica*) and one white oak (*Quercus alba*).

Exotic Plant Species

Exotic Trees

No exotic trees were monitored in Manassas in 2008.

Vines on Trees

Vines were found on 2/3rds of the trees in Manassas and were in the crown of ½ of the trees (Table 51). Vines were particularly common on the eastern red cedar trees in MANA-0218.

Table 51. Presence of vines in Manassas.

Plot	Trees	Trees with Vines	Trees with Vines in Crown
MANA-0011	20	18	15
MANA-0131	-	-	-
MANA-0205	32	-	-
MANA-0218	77	63	49
MANA-0240	29	20	16
Total	158	101	80

The most common vines in Manassas were Japanese honeysuckle (*Lonicera japonica*) and grape (*Vitis* spp. - Table 52).

Table 52. Species of vines in trees in Manassas.

Latin Name	Common Name	Trees with Vines	Tree with vines in crown
¹ <i>Lonicera japonica</i>	Japanese honeysuckle	54	38
<i>Parthenocissus quinquefolia</i>	Virginia creeper	18	14
<i>Toxicodendron radicans</i>	poison ivy	16	14
<i>Vitis</i> spp.	grape	57	53

¹ Non-native species.

Exotic Shrubs

Over half of the shrubs and nearly two-thirds of the shrub seedlings are exotic. Autumn olive (*Elaeagnus umbellata*) was the most common exotic shrub (Table 50).

Exotic Herbaceous Plants

Exotics were found in four plots in Manassas, and were found in 63% of all quadrats (Table 53).

Table 53. Frequency of exotic herbaceous plants in Manassas.

Plot	Quadrats with exotics	Number of exotic species
MANA-0011	10	4
MANA-0131	4	2
MANA-0205	-	-
MANA-0218	12	5
MANA-0240	12	6
Total		9

Nine herbaceous exotic species were found on the plots. Of these, Japanese stiltgrass was the most widespread and had the highest percent cover (Table 54).

Table 54. Cover of herbaceous exotic plants in Manassas.

Latin name	Common name	Plots	Mean % cover when present
<i>Alliaria petiolata</i>	garlic mustard	2	1%
<i>Duchesnea indica</i>	Indian strawberry	3	1%
<i>Glechoma hederacea</i>	ground ivy	1	12%
<i>Lespedeza cuneata</i>	Chinese lespedeza	1	5%
<i>Lonicera japonica</i>	Japanese honeysuckle	3	<1%
<i>Lonicera</i> spp.	honeysuckle	1	<1%
<i>Microstegium vimineum</i>	Japanese stiltgrass	4	26%
<i>Polygonum caespitosum</i>	Oriental ladythumb	1	1%
<i>Rubus phoenicolasius</i>	wineberry	1	2%

Monocacy National Battlefield

One forest vegetation plot was monitored in Monocacy in 2008 (Figure 7).

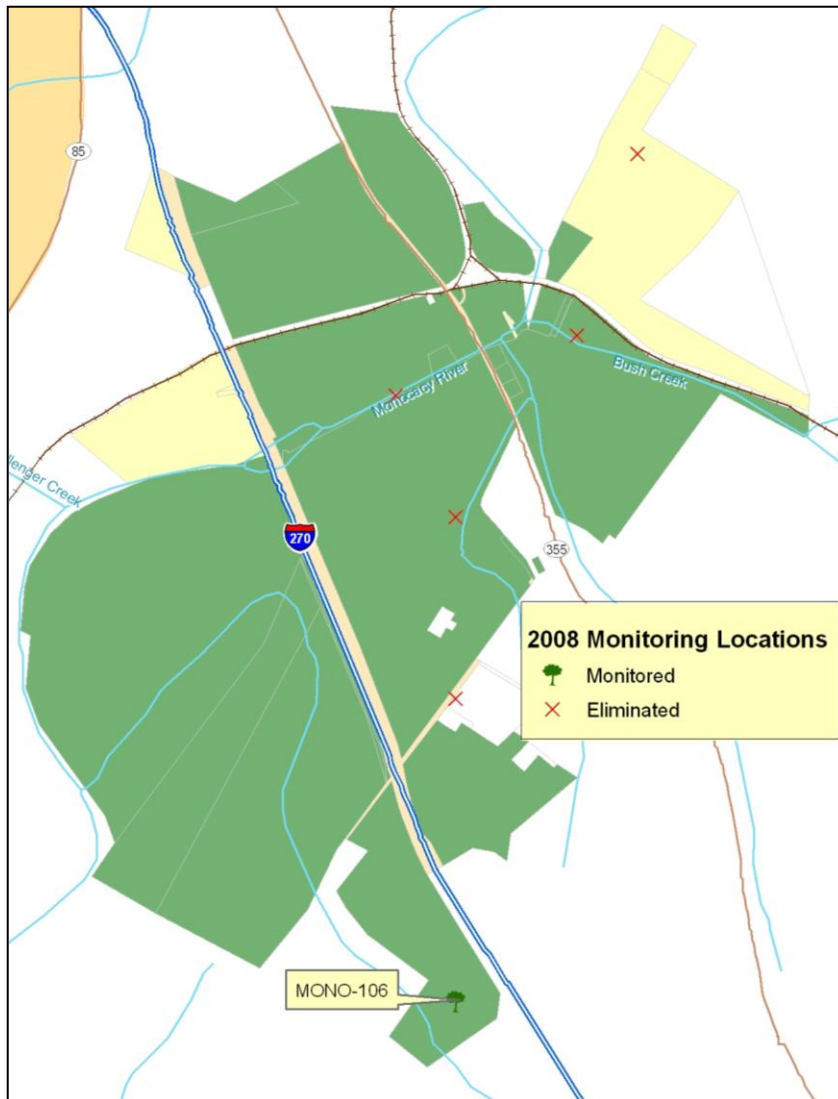


Figure 7. Locations considered for forest monitoring in Monocacy.

Forest Communities

The tree density on the single Monocacy plot is higher than the regional average (Table 55). Eleven different tree species were found on the plot (Table 56).

Table 55. Density, basal area (BA) and richness of trees, saplings and seedlings in Monocacy.

Plot	Trees	Trees/ ha	Tree BA(cm ²)/ha	Tree Species	Saplings	Saplings/ha	Sapling BA(cm ²)/ha	Sapling Species	Seedlings	Seedlings/ha	Species
MONO-0106	31	439	339,000	7	6	70754	14,700	4	10	8330	5

Table 56. Tree species found on the forest monitoring plots in Monocacy.

Latin Name	Common Name	Trees	Tree BA cm ² /ha	Trees with vines/in canopy	Saplings	Sapling BA cm ² /ha	Seedlings
<i>Acer rubrum</i>	red maple	4	19,500	-	-	-	-
<i>Carpinus caroliniana</i>	American hornbeam	-	-	-	-	-	1
<i>Carya alba</i>	mockernut	-	-	-	1	6250	-
	hickory						
<i>Carya glabra</i>	pignut hickory	1	16,500	-	-	-	-
<i>Celtis occidentalis</i>	common hackberry	-	-	-	-	-	1
<i>Fagus grandifolia</i>	American beech	7	59,400	-	1	472	5
<i>Fraxinus americana</i>	white ash	-	-	-	-	-	2
<i>Liriodendron tulipifera</i>	tulip poplar	6	79,700	-	-	-	-
<i>Nyssa sylvatica</i>	blackgum	8	36,900	-	1	1300	-
<i>Prunus serotina</i>	black cherry	1	11,400	-	3	6840	1
<i>Quercus prinus</i>	chestnut oak	4	115,000	-	-	-	-

No shrubs were found on the Monocacy plot.

Forest Pest and Diseases

One tree, an American beech (*Fagus grandifolia*) was afflicted with gypsy moth.

Exotic Plant Species

Exotic Trees

No exotic trees were found on the Monocacy plot (Table 56).

Vines on Trees

None of the trees on the Monocacy plot had vines growing on them (Table 56).

Exotic Shrubs

No exotic shrubs were found on the Monocacy plot.

Exotic Herbaceous Plants

Exotics herbaceous species were found in nearly all of the quadrats on the Monocacy Plot (Table 57).

Table 57. Frequency of exotic herbaceous plants in Monocacy.

Plot	Quadrats with exotics	Number of exotic species
MONO-0106	11	6

None of the six herbaceous exotic species found had a high percent cover (Table 58).

Table 58. Cover of herbaceous exotic plants in Monocacy.

Latin name	Common name	Plots	Mean % cover when present
<i>Alliaria petiolata</i>	garlic mustard	1	2%
<i>Ampelopsis brevipedunculata</i>	porcelainberry	1	<1%
<i>Celastrus orbiculatus</i>	Oriental bittersweet	1	<1%
<i>Lonicera japonica</i>	Japanese honeysuckle	1	<1%
<i>Microstegium vimineum</i>	Japanese stiltgrass	1	6%
<i>Polygonum caespitosum</i>	Oriental ladythumb	1	4%

National Capital Parks East

Eleven plots were monitored in NACE in 2008 (Figure 8). These included three plots in Piscataway, two plots in Greenbelt, two plots along the Baltimore-Washington Parkway and one each in the Fort Circle Trail, near Oxon Farm and along the Suitland Parkway.

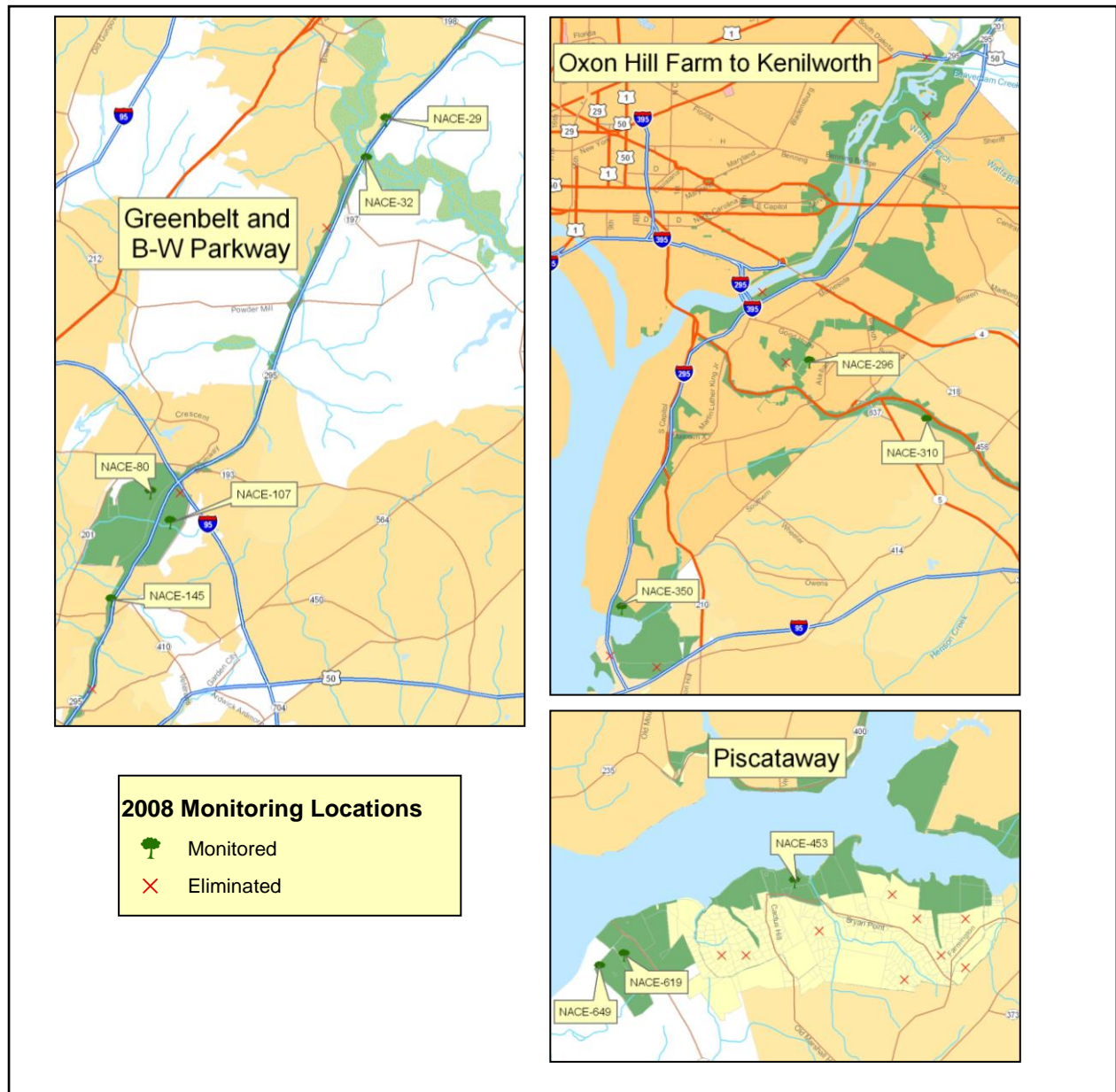


Figure 8. Locations considered for monitoring in National Capital Parks East.

Forest Communities

Tree density and basal area for NACE are presented in Table 59.

Table 59. Density, basal area (BA) and richness of trees, saplings and seedlings in NACE.

Plot	Trees	Trees/ha	Tree BA(cm ²)/ha	Tree Species	Saplings	Saplings/ha	Sapling BA(cm ²)/ha	Sapling Species	Seedlings	Seedlings/ha	Species
NACE-0029	35	495	390,000	9	2	236	719	1	7	5830	3
NACE-0032	13	184	242,000	6	-	-	-	-	6	5000	4
NACE-0080	33	467	242,000	9	6	707	19,800	3	2	1670	1
NACE-0107	31	439	254,000	6	11	1300	27,400	3	4	3330	1
NACE-0145	32	453	213,000	7	3	354	6680	3	15	12,500	5
NACE-0296	34	481	228,000	9	8	943	19,500	6	2	1670	2
NACE-0310	20	283	148,000	6	6	707	12,500	5	2	1670	2
NACE-0350	31	439	148,000	2	-	-	-	-	3	2500	3
NACE-0453	36	509	335,000	4	15	1770	14,900	2	3	2500	2
NACE-0619	26	368	364,000	8	2	236	13,400	2	1	833	1
NACE-0649	8	113	99,500	3	5	589	7650	1	3	2500	3
Total	299	385	242,000	34	58	622	11,100	18	48	3640	16

Overall, 38 tree species were found on the eleven plots in NACE (Table 60).

Table 60. Tree species found on the forest monitoring plots in NACE.

Latin Name	Common Name	Trees	Tree BA cm ² /ha	Trees with vines/in crown	Saplings	Sapling BA cm ² /ha	Seedlings
<i>Acer negundo</i>	box elder	6	1640	4/3	2	632	2
<i>Acer rubrum</i>	red maple	36	23,800	13/3	4	1150	1
¹ <i>Ailanthus altissima</i>	tree of heaven	2	835	2/1	1	118	-
<i>Asimina triloba</i>	pawpaw	-	-	-	14	1070	3
<i>Carpinus</i>	American	5	1370	3/3	-	-	1
<i>caroliniana</i>	hornbeam						
<i>Carya alba</i>	mockernut	1	150	1/-	-	-	-
	hickory						
¹ <i>Catalpa</i>	southern catalpa	1	145	1/1	-	-	-
<i>bignonioides</i>							
<i>Cornus florida</i>	flowering dogwood	1	181	1/-	-	-	-
<i>Fagus grandifolia</i>	American beech	14	6880	2/-	6	1230	1
<i>Fraxinus americana</i>	white ash	2	4150	1/-	1	161	6
<i>Fraxinus</i>	green ash	2	4930	2/1	-	-	3
<i>pennsylvanica</i>							
<i>Fraxinus profunda</i>	pumpkin ash	25	17,300	11/-	-	-	-
<i>Ilex opaca</i>	American holly	1	156	1/-	5	2090	-
<i>Juniperus</i>	eastern red cedar	-	-	-	5	697	1
<i>virginiana</i>							
<i>Liquidambar</i>	sweetgum	48	41,200	34/8	5	740	6
<i>styraciflua</i>							
<i>Liriodendron</i>	tulip poplar	13	26,800	8/3	1	225	-
<i>tulipifera</i>							
¹ <i>Malus</i> spp.	apple	-	-	-	-	-	1
¹ <i>Morus alba</i>	white mulberry	1	257	1/1	1	354	-
<i>Nyssa sylvatica</i>	blackgum	19	4530	3/-	4	622	1
<i>Pinus rigida</i>	pitch pine	1	826	1/-	-	-	-
<i>Pinus strobus</i>	white pine	2	439	2/2	-	-	-
<i>Pinus virginiana</i>	Virginia pine	8	9340	5/-	-	-	-
<i>Platanus</i>	American	1	8680	1/-	2	322	-
<i>occidentalis</i>	sycamore						
<i>Populus deltoides</i>	eastern cottonwood	27	13,100	3/-	-	-	-
¹ <i>Prunus avium</i>	sweet cherry	1	747	1/1	1	279	-
<i>Prunus serotina</i>	black cherry	11	11,300	11/6	1	268	3
¹ <i>Pyrus calleryana</i>	Callery pear	-	-	-	1	21	-
¹ <i>Pyrus</i> spp.	pear	1	1680	1/1	-	-	-
<i>Quercus alba</i>	white oak	11	13,800	1/-	1	761	-
<i>Quercus coccinea</i>	scarlet oak	5	4890	1/-	-	-	-
<i>Quercus falcata</i>	southern red oak	2	1500	-	-	-	-
<i>Quercus palustris</i>	pin oak	2	3740	-	-	-	5
<i>Quercus phellos</i>	willow oak	6	8910	2/1	-	-	3
<i>Quercus</i> spp.	oak	1	342	1/-	-	-	-
<i>Quercus X bushii</i>	Bush's oak	1	265	-	-	-	-
<i>Robinia pseudo-</i>	black locust	25	18,400	24/16	-	-	1
<i>acacia</i>							
<i>Sassafras albidum</i>	sassafras	10	3210	8/3	-	-	10
<i>Ulmus americana</i>	American elm	7	6650	6/5	3	375	-

¹Non-native species.

The two white pines (*Pinus strobus*) were trees that were found in plot NACE-0310 along the Suitland Parkway. Although white pine is native to the National Capital Region, these individual trees were originally planted.

The number and basal area of shrubs varied greatly across NACE (Table 61).

Table 61. Density, basal area, seedling density and species richness of shrubs in NACE.

Plot	Shrubs	Shrubs/ha	Species	BA(cm ²)/ha	Seedlings	Seedlings/ha
NACE-0029	-	-	-	-	-	-
NACE-0032	5	589	1	358,000	13	10,800
NACE-0080	3	354	1	3600	-	-
NACE-0107	-	-	-	-	-	-
NACE-0145	1	118	1	2040	3	2500
NACE-0296	1	118	1	625	-	-
NACE-0310	-	-	-	-	2	1670
NACE-0350	-	-	-	-	-	-
NACE-0453	9	1060	2	51,100	4	3330
NACE-0619	-	-	-	-	-	-
NACE-0649	-	-	-	-	-	-
Total	19	204	5	37,800	22	1670

Northern spicebush (*Lindera benzoin*) is the most common shrub in NACE (Table 62).

Table 62. Shrub species found on forest monitoring plots in NACE.

Latin Name	Common Name	Shrubs	Seedlings
<i>Castanea pumila</i>	chinkapin	1	-
<i>Ilex verticillata</i>	common winterberry	-	3
<i>Kalmia latifolia</i>	mountain laurel	3	-
<i>Lindera benzoin</i>	northern spicebush	11	14
¹ <i>Lonicera maackii</i>	Amur honeysuckle	1	-
<i>Viburnum dentatum</i>	southern arrowwood	-	4
<i>Viburnum prunifolium</i>	blackhaw	3	1

¹Non-native species.

Forest Pests and Diseases

No targeted forest pests or diseases were found in NACE.

Exotic Plant Species

Exotic Trees

Seven exotic tree species were found (Table 60). They make up 2.0% of all individuals and 1.5% of all basal area in the tree layer, 6.9% of all individuals and 7.0% of all basal area in the sapling layer and are 2.1% of all individuals in the seedling layer.

Vines in Trees

Vines are very common on trees in NACE. Over 52% of all trees have vines in them, and over 19% have vines in their crowns (Table 63). In each of the plots along the southern portion of the Baltimore Washington Parkway, the Suitland Parkway and the Fort Circle parks, nearly every tree had vines.

Table 63. Presence of vines in NACE.

Plot	Trees	Trees with Vines	Trees with Vines in Crown
NACE-0029	35	8	2
NACE-0032	13	9	6
NACE-0080	33	3	-
NACE-0107	31	14	-
NACE-0145	32	30	1
NACE-0296	34	33	23
NACE-0310	20	20	13
NACE-0350	31	6	1
NACE-0453	36	17	1
NACE-0619	26	9	6
NACE-0649	8	7	6
Total	299	156	59

Eastern poison ivy (*Toxicodendron radicans*) was the most common vine but Japanese honeysuckle (*Lonicera japonica*) was the most common vine in the crowns of trees (Table 68).

Table 64. Species of vines in trees in NACE.

Latin Name	Common Name	Trees with Vines	Tree with vines in crown
¹ <i>Ampelopsis brevipedunculata</i>	porcelainberry	11	9
<i>Campsis radicans</i>	trumpet creeper	2	-
¹ <i>Celastrus orbiculatus</i>	Oriental bittersweet	10	8
¹ <i>Clematis terniflora</i>	sweet autumn clematis	2	-
¹ <i>Euonymus fortunei</i>	winter creeper	2	2
¹ <i>Hedera helix</i>	English ivy	34	22
¹ <i>Lonicera japonica</i>	Japanese honeysuckle	52	34
<i>Parthenocissus quinquefolia</i>	Virginia creeper	36	21
¹ <i>Pueraria montana</i>	kudzu	14	12
¹ <i>Rosa multiflora</i>	multiflora rose	7	6
<i>Smilax</i> spp.	greenbrier	49	7
<i>Toxicodendron radicans</i>	poison ivy	71	20
<i>Vitis</i> spp.	grape	38	33

¹Non-native species

Exotic Shrubs

Amur honeysuckle (*Lonicera maackii*) was the only exotic shrub species found. One shrub was found, which is 5.2% of all shrubs. No seedlings of this species were found on the plots.

Exotic Herbaceous Plants

Ten out of the eleven plots in NACE had exotic herbaceous species (Table 65).

Table 65. Frequency of exotic herbaceous plants in NACE.

Park	Quadrats with exotics	Number of exotic species
NACE-0029	11	4
NACE-0032	11	6
NACE-0080	-	-
NACE-0107	4	2
NACE-0145	10	1
NACE-0296	12	8
NACE-0310	12	5
NACE-0350	12	5
NACE-0453	1	1
NACE-0619	8	4
NACE-0649	9	6
Total		14

Most exotics species had a fairly low percent cover (Table 66), except for English Ivy (*Hedera helix*), Japanese honeysuckle (*Lonicera japonica*), Japanese stiltgrass (*Microstegium vimineum*) and kudzu (*Pueraria montana*).

Table 66. Cover of herbaceous exotic plants in NACE.

Latin name	Common name	Plots	Mean % cover when present
<i>Alliaria petiolata</i>	garlic mustard	4	<1%
<i>Ampelopsis brevipedunculata</i>	Porcelain berry	3	1%
<i>Berberis thunbergii</i>	Japanese barberry	1	<1%
<i>Clematis orbiculatus</i>	Oriental bittersweet	5	2%
<i>Duchesnea indica</i>	Indian strawberry	3	<1%
<i>Hedera helix</i>	English ivy	3	25%
<i>Lonicera japonica</i>	Japanese honeysuckle	10	10%
<i>Lonicera</i> spp.	honeysuckle	2	3%
<i>Lysimachia nummularia</i>	creeping jenny	1	6%
<i>Microstegium vimineum</i>	Japanese stiltgrass	3	15%
<i>Polygonum caespitosum</i>	Oriental ladythumb	2	<1%
<i>Polygonum perfoliatum</i>	Mile-a-minute	2	4%
<i>Pueraria montana</i>	kudzu	1	13%
<i>Rosa multiflora</i>	multiflora rose	2	5%

Prince William Forest Park

Thirty-three plots were monitored in Prince William in 2008. The plots were located throughout the park (Figure 9).

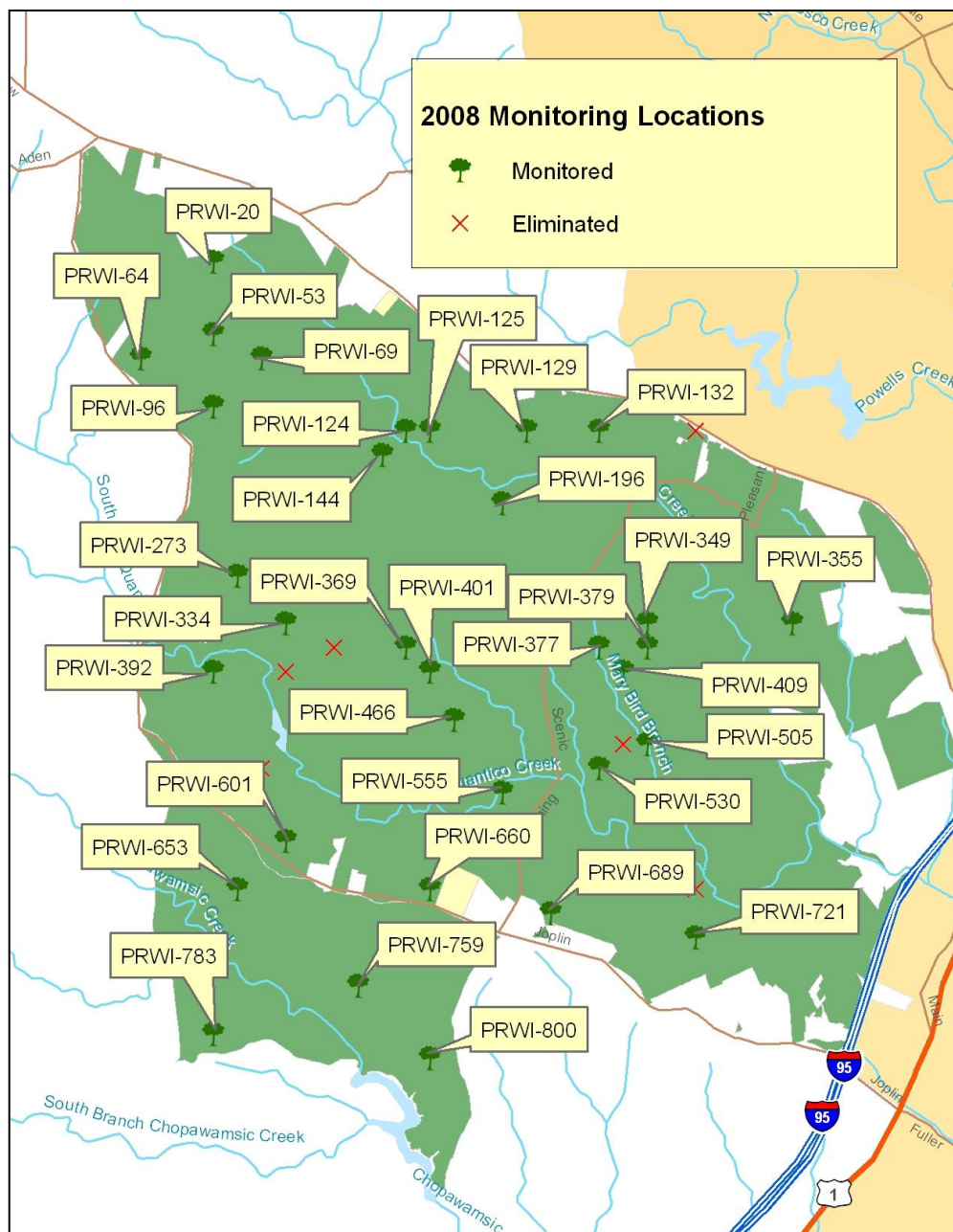


Figure 9. Locations considered for forest monitoring in Prince William.

Forest Communities

Sapling density and basal area was higher than the other parks in the region. More species were found as saplings in Prince William than in the other parks, despite the fact that fewer tree species were found in Prince William compared to most parks. Tree seedling density was higher

than the regional average and species richness was the highest. Tree seedlings were found on all but two of the plots (Table 67).

Table 67. Density, basal area (BA) and richness of trees, saplings, and seedlings in Prince William.

Plot	Trees	Trees /ha	Tree BA(cm ²)/ha	Tree Species	Saplings	Saplings/ ha	Sapling BA(cm ²)/ha	Sapling Species	Seedlings	Seedlings /ha	Species
PRWI-0020	32	453	214,000	8	8	943	26,600	2	-	-	-
PRWI-0053	39	552	267,000	9	9	1060	27,300	3	4	3330	4
PRWI-0064	23	325	374,000	8	11	1300	11,700	4	53	44,200	7
PRWI-0069	46	651	406,000	7	12	1420	35,500	5	2	1670	2
PRWI-0096	26	368	279,000	7	9	1060	34,000	3	5	4170	2
PRWI-0124	24	340	269,000	8	16	1890	46,300	5	15	12,500	5
PRWI-0125	26	368	147,000	10	11	1300	25,600	5	7	5830	3
PRWI-0129	24	340	156,000	7	9	1060	33,200	6	11	9170	5
PRWI-0132	42	594	329,000	12	14	1650	36,900	5	1	833	1
PRWI-0144	33	467	249,000	9	10	1180	23,900	7	4	3330	3
PRWI-0196	21	297	291,000	9	15	1770	21,500	3	2	1670	1
PRWI-0273	10	141	84,500	3	3	354	6080	2	60	50,000	8
PRWI-0334	16	226	269,000	7	-	-	-	-	22	18,300	6
PRWI-0349	39	552	236,000	10	15	1770	18,100	3	3	2500	2
PRWI-0355	22	311	211,000	4	6	707	68000	3	3	2500	2
PRWI-0369	25	354	323,000	8	14	1650	39,000	4	6	5000	3
PRWI-0377	31	439	298,000	6	6	707	13,000	3	6	5000	2
PRWI-0379	31	439	156,000	7	29	3420	51,400	9	4	3330	4
PRWI-0392	29	410	144,000	10	43	5070	50,500	9	14	11,700	5
PRWI-0401	32	453	293,000	9	16	1890	28,600	6	10	8330	4
PRWI-0409	40	566	250,000	6	20	2360	33,900	3	4	3330	2
PRWI-0466	34	481	246,000	7	13	1530	38,500	4	2	1670	2
PRWI-0505	18	255	306,000	6	2	236	365	1	6	5000	3
PRWI-0530	22	311	346,000	8	4	472	10,500	2	2	1670	2
PRWI-0555	30	424	258,000	9	12	1410	31,900	5	1	833	1
PRWI-0601	43	608	258,000	7	16	1890	43,300	6	10	8330	5
PRWI-0653	27	382	229,000	6	8	943	28,200	2	2	1670	1
PRWI-0660	41	580	278,000	9	8	943	21,900	4	2	1670	2
PRWI-0689	34	481	238,000	10	13	1530	27,800	4	2	1670	2
PRWI-0721	23	325	296,000	8	13	1530	16,000	5	2	1670	2
PRWI-0759	18	255	233,000	5	13	1530	22,100	4	5	4170	3
PRWI-0783	19	269	197,000	4	3	354	11,600	1	-	-	-
PRWI-0800	10	141	154,000	4	11	1300	33,800	2	10	8330	5
Total	930	399	251,000	24	392	1400	25,900	19	280	7070	23

Thirty different tree species were found in Prince William (Table 68).

Table 68. Tree species found on forest monitoring plots in Prince William.

Latin Name	Common Name	Trees	Tree BA cm ² /ha	Trees with vines/in crown	Saplings	Sapling BA cm ² /ha	Seedlings
<i>Acer rubrum</i>	red maple	123	16,600	9/2	43	3600	9
<i>Amelanchier arborea</i>	common serviceberry	-	-	-	-	-	5
<i>Asimina triloba</i>	pawpaw	-	-	-	-	-	7
<i>Carpinus caroliniana</i>	American hornbeam	6	442	-	8	393	22
<i>Carya alba</i>	mockernut	25	3330	-	9	593	7
<i>Carya glabra</i>	hickory	31	8120	-	3	386	6
<i>Cornus florida</i>	pignut hickory	23	1250	1/-	17	1910	-
<i>Fagus grandifolia</i>	flowering dogwood	135	18,600	8/2	145	9310	33
<i>Fraxinus americana</i>	American beech white ash	4	547	1/-	3	71	-
<i>Ilex opaca</i>	American holly	8	563	-	38	1950	31
<i>Juniperus virginiana</i>	eastern red cedar	1	79	1/1	2	143	2
<i>Liquidambar styraciflua</i>	sweetgum	19	3520	2/2	8	464	1
<i>Liriodendron tulipifera</i>	tulip poplar	135	58,300	2/-	-	-	1
<i>Nyssa sylvatica</i>	blackgum	68	7680	1/-	66	5320	4
<i>Pinus echinata</i>	shortleaf pine	2	500	-	-	-	-
<i>Pinus rigida</i>	pitch pine	2	986	1/-	-	-	-
<i>Pinus virginiana</i>	Virginia pine	160	46,700	23/-	1	121	4
<i>Platanus occidentalis</i>	American sycamore	2	308	-	-	-	-
<i>Prunus serotina</i>	black cherry	-	-	-	-	-	1
<i>Quercus alba</i>	white oak	99	41,800	1/-	35	725	100
<i>Quercus coccinea</i>	scarlet oak	35	21,400	2/-	-	-	33
<i>Quercus falcata</i>	southern red oak	21	8900	-	3	143	2
<i>Quercus phellos</i>	willow oak	1	1530	-	-	-	1
<i>Quercus prinus</i>	chestnut oak	3	580	-	-	-	1
<i>Quercus rubra</i>	northern red oak	7	4040	-	1	4	1
<i>Quercus velutina</i>	black oak	18	5200	-	1	64	-
<i>Quercus X bushii</i>	Bush's oak	-	-	-	2	157	6
<i>Quercus spp.</i>	oak	-	-	-	-	-	1
<i>Sassafras albidum</i>	sassafras	2	83	-	6	593	2
<i>Ulmus americana</i>	American elm	-	-	-	1	14	-

Shrubs were scattered in Prince William (Table 69).

Table 69. Density, basal area, seedling density and species richness of shrubs in Prince William.

Plot	Shrubs	Shrubs per ha	Species	BA(cm ²)/ha	Seedlings	Seedlings/ha
PRWI-0020	-	-	-	-	-	-
PRWI-0053	4	472	1	3060	-	-
PRWI-0064	5	589	1	9400	1	833
PRWI-0069	-	-	-	-	-	-
PRWI-0096	-	-	-	-	-	-
PRWI-0124	1	118	1	236	-	-
PRWI-0125	4	472	2	8660	-	-
PRWI-0129	-	-	-	-	-	-
PRWI-0132	-	-	-	-	-	-
PRWI-0144	15	1770	1	60,500	2	1670
PRWI-0196	2	236	1	37,300	-	-
PRWI-0273	26	3060	5	190,000	3	2500
PRWI-0334	56	6600	3	429,000	18	15,000
PRWI-0349	-	-	-	-	-	-
PRWI-0355	1	118	1	1070	-	-
PRWI-0369	3	354	1	58,900	-	-
PRWI-0377	-	-	-	-	-	-
PRWI-0379	-	-	-	-	-	-
PRWI-0392	1	118	1	2310	-	-
PRWI-0401	10	1180	1	140,000	-	-
PRWI-0409	2	236	1	589	-	-
PRWI-0466	-	-	-	-	2	1670
PRWI-0505	-	-	-	-	-	-
PRWI-0530	-	-	-	-	-	-
PRWI-0555	39	4600	1	190,000	12	10,000
PRWI-0601	23	2710	2	62,200	2	1670
PRWI-0653	1	118	1	943	6	500
PRWI-0660	-	-	-	-	-	-
PRWI-0689	-	-	-	-	-	-
PRWI-0721	-	-	-	-	-	-
PRWI-0759	13	1530	1	43,100	3	2500
PRWI-0783	49	5780	1	423,000	2	1670
PRWI-0800	2	236	1	4030	-	-
Total	257	918	5	50,400	51	1290

Seven species of shrubs were found in the microplots (Table 70). Mountain laurel (*Kalmia latifolia*) was by far the most common.

Table 70. Shrub species found in Prince William.

Latin Name	Common Name	Shrubs	Seedlings
<i>Euonymus americana</i>	strawberry bush	-	2
<i>Ilex verticillata</i>	common winterberry	-	1
<i>Kalmia latifolia</i>	mountain laurel	215	45
<i>Lyonia ligustrina</i>	maleberry	6	3
<i>Vaccinium corymbosum</i>	highbush blueberry	2	-
<i>Vaccinium fuscatum</i>	black highbush blueberry	33	-
<i>Viburnum dentatum</i>	southern arrowwood	1	-

Forest Pests and Diseases

No targeted forest pests or diseases were found in Prince William.

Exotic Plant Species

Exotic Trees

No exotic trees were found in Prince William.

Vines on Trees

Relatively few trees have vines growing on them, and less than 1% have vines in their crown. (Table 71).

Table 71. Presence of vines in Prince William.

Plot	Trees	Trees with Vines	Trees with Vines in Crown
PRWI-0020	32	-	-
PRWI-0053	39	-	-
PRWI-0064	23	-	-
PRWI-0069	46	12	1
PRWI-0096	26	-	-
PRWI-0124	24	1	-
PRWI-0125	42	-	-
PRWI-0129	33	-	-
PRWI-0132	21	-	-
PRWI-0144	10	2	-
PRWI-0196	16	-	-
PRWI-0273	10	-	-
PRWI-0334	16	-	-
PRWI-0349	39	-	-
PRWI-0355	22	-	-
PRWI-0369	25	5	-
PRWI-0377	31	-	-
PRWI-0379	31	17	7
PRWI-0392	29	-	-
PRWI-0401	32	-	-
PRWI-0409	40	5	-
PRWI-0466	34	6	-
PRWI-0505	18	-	-
PRWI-0530	22	-	-
PRWI-0555	30	-	-
PRWI-0601	43	4	-
PRWI-0653	27	-	-
PRWI-0660	41	-	-
PRWI-0689	34	-	-
PRWI-0721	23	-	-
PRWI-0759	18	-	-
PRWI-0783	19	-	-
PRWI-0800	10	-	-
Total	930	52	8

Most of the vines that are growing on trees are *Smilax* species (Table 72).

Table 72. Species of vines in trees in Prince William.

Latin Name	Common Name	Trees with Vines	Tree with vines in crown
¹ <i>Lonicera japonica</i>	Japanese honeysuckle	2	2
<i>Parthenocissus quinquefolia</i>	Virginia creeper	2	-
<i>Smilax</i> spp.	greenbrier	49	7
<i>Toxicodendron radicans</i>	poison ivy	2	1
<i>Vitis</i> spp.	grape	2	2

¹Non-native species.

Exotic Shrubs

No exotic shrubs were found on the Prince William plots

Exotic Herbaceous Plants

Few of the plots at Prince William had exotic herbaceous plants present (Table 73).

Table 73. Presence of exotic herbaceous plants in Prince William.

Plot	Quadrats with Exotics	Number of Exotic Species
PRWI-0020	-	-
PRWI-0053	-	-
PRWI-0064	-	-
PRWI-0069	-	-
PRWI-0096	-	-
PRWI-0124	-	-
PRWI-0125	2	1
PRWI-0129	-	-
PRWI-0132	-	-
PRWI-0144	-	-
PRWI-0196	-	-
PRWI-0273	6	1
PRWI-0334	4	1
PRWI-0349	-	-
PRWI-0355	-	-
PRWI-0369	-	-
PRWI-0377	6	2
PRWI-0379	4	1
PRWI-0392	-	-
PRWI-0401	-	-
PRWI-0409	-	-
PRWI-0466	-	-
PRWI-0505	12	2
PRWI-0530	-	-
PRWI-0555	-	-
PRWI-0601	1	1
PRWI-0653	-	-
PRWI-0660	-	-
PRWI-0689	-	-
PRWI-0721	-	-
PRWI-0759	-	-
PRWI-0783	-	-
PRWI-0800	-	-
Total		2

Only two species were found (Table 74) none of which had a high percent cover.

Table 74. Cover of exotic plants in Prince William.

Latin name	Common name	Plots	Mean % cover when present
<i>Lonicera japonica</i>	Japanese honeysuckle	4	<1%
<i>Microstegium vimineum</i>	Japanese stiltgrass	5	5%

Rock Creek Park

Seven forest plots were monitored in Rock Creek in 2008 (Figure 10).

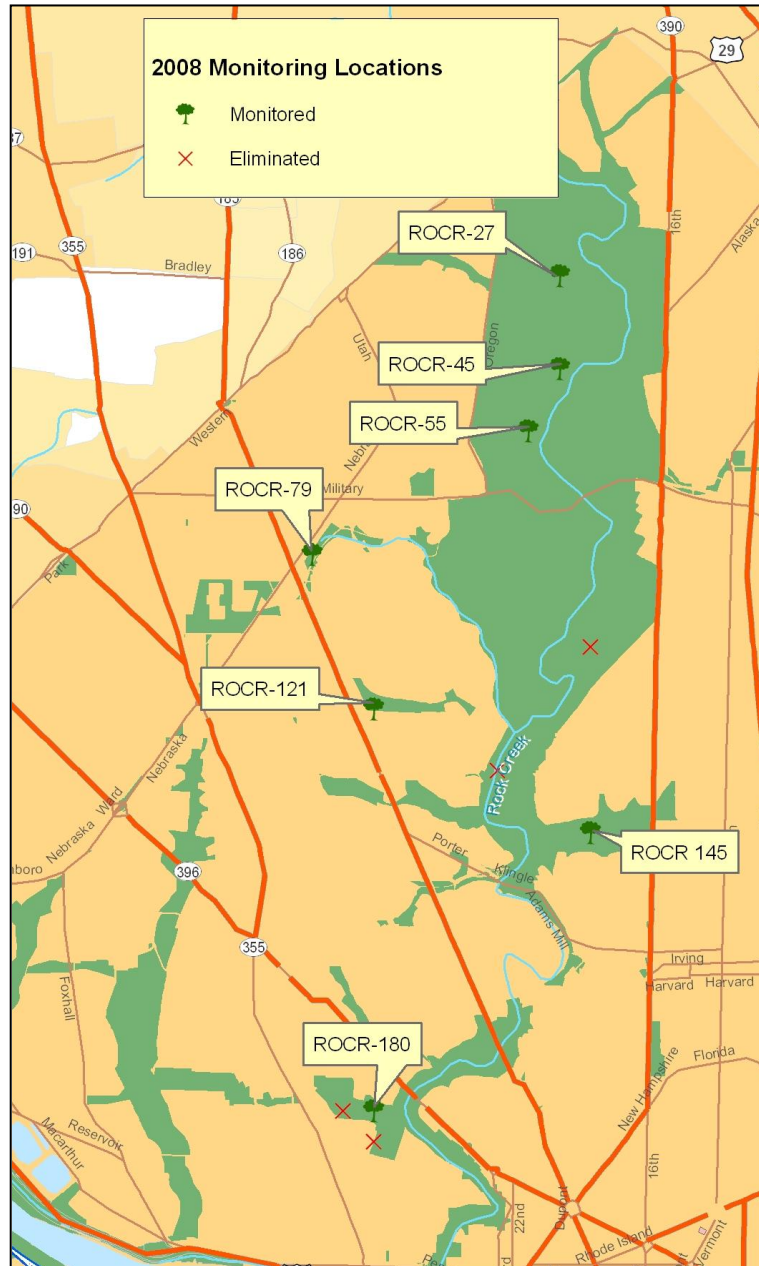


Figure 10. Locations considered for monitoring in Rock Creek.

Forest Communities

Information on tree density and basal area is reported in Table 75. Thirty three tree species were found in Rock Creek (Table 76).

Table 75. Density, basal area (BA) and richness of trees saplings and seedlings in Rock Creek.

Plot	Trees	Trees /ha	Tree BA(cm ²)/ha	Tree Species	Saplings	Saplings/ ha	Sapling BA(cm ²)/ha	Sapling Species	Seedlings	Seedlings /ha	Species
ROCR-0027	22	311	455,000	8	1	118	731	1	1	833	1
ROCR-0045	24	340	381,000	7	2	236	2870	2	5	4170	4
ROCR-0055	16	226	409,000	5	3	354	6260	3	3	2500	2
ROCR-0079	27	382	397,000	10	6	707	11,400	4	2	1670	2
ROCR-0121	18	255	376,000	8	4	472	21,100	3	10	8330	6
ROCR-0145	30	424	428,000	9	20	2360	40,300	5	3	2500	2
ROCR-0180	29	410	227,000	10	5	589	4410	3	1	833	1
Total	166	355	382,000	30	41	691	12,500	14	25	2980	13

Table 76. Tree species found in Rock Creek.

Latin Name	Common Name	Trees	Tree BA cm ² /ha	Trees with vines/ in crown	Saplings	Sapling BA cm ² /ha	Seedlings
<i>Acer negundo</i>	box elder	7	6530	5/2	-	-	1
¹ <i>Acer platanoides</i>	Norway maple	3	806	2/-	1	825	-
<i>Acer rubrum</i>	red maple	8	4780	3/-	5	2310	1
<i>Acer saccharum</i>	sugar maple	15	7060	10/2	3	455	1
<i>Amelanchier arborea</i>	common serviceberry	-	-	-	2	101	1
<i>Asimina triloba</i>	pawpaw	1	158	-	-	-	2
<i>Carpinus caroliniana</i>	American hornbeam	1	198	-	1	337	-
<i>Carya alba</i>	mockernut	1	1730	1/-	5	792	-
	hickory						
<i>Carya glabra</i>	pignut hickory	1	2010	1/-	-	-	-
¹ <i>Catalpa bignonioides</i>	southern catalpa	1	568	1/-	-	-	-
<i>Cornus florida</i>	flowering dogwood	1	176	1/-	-	-	1
<i>Fagus grandifolia</i>	American beech	24	23,800	3/1	7	2930	4
<i>Fraxinus americana</i>	white ash	3	2020	1/1	2	202	3
<i>Ilex opaca</i>	American holly	1	319	1/1	2	438	-
<i>Liriodendron tulipifera</i>	tulip poplar	37	156,000	13/1	1	1210	-
¹ <i>Malus prunifolia</i>	plumleaf crabapple	1	196	-	-	-	-
¹ <i>Malus sieboldii</i>	toringo crabapple	-	-	-	1	185	-
¹ <i>Morus alba</i>	white mulberry	2	3890	2/2	2	236	-
<i>Nyssa sylvatica</i>	blackgum	12	4880	1/1	7	2020	3
<i>Populus deltoides</i>	eastern cottonwood	2	16,100	2/1	-	-	-
¹ <i>Prunus avium</i>	sweet cherry	1	261	1/1	-	-	-
<i>Prunus serotina</i>	black cherry	-	-	-	-	-	4
<i>Quercus alba</i>	white oak	17	83,300	5/1	-	-	2
<i>Quercus falcata</i>	southern red oak	4	15,700	-	-	-	-
<i>Quercus prinus</i>	chestnut oak	3	10,400	-	-	-	-
<i>Quercus rubra</i>	northern red oak	5	14,200	-	-	-	1
<i>Quercus stellata</i>	post oak	1	1800	-	-	-	-
<i>Quercus velutina</i>	black oak	4	18,100	2/-	-	-	-
<i>Robinia pseudoacacia</i>	black locust	1	1170	1/-	-	-	-
<i>Sassafras albidum</i>	sassafras	1	269	-	-	-	-
<i>Tilia americana</i>	American basswood	1	491	-	-	-	-
<i>Tsuga canadensis</i>	eastern hemlock	1	2464	1/-	-	-	-
<i>Ulmus americana</i>	American elm	6	2747	3/1	2	404	1

¹Non-native species.

The density of shrubs was higher than in most parks, and Rock Creek had the highest density of shrub seedlings of any park (Table 77).

Table 77. Density, basal area, seedling density and species richness of shrubs in Rock Creek.

Plot	Shrubs	Shrubs/ha	Species	BA(cm ²)/ha	Seedlings	Seedlings/ha
ROCR-0027	27	3180	2	69,100	25	20,800
ROCR-0045	-	-	-	-	8	6670
ROCR-0055	10	1180	1	20,900	17	14,200
ROCR-0079	22	2590	3	343,000	6	5000
ROCR-0121	-	-	-	-	36	30,000
ROCR-0145	1	118	1	20,600	1	833
ROCR-0180	-	-	-	-	3	2500
Total	60	1010	5	64,900	96	11,400

Eight shrub species were found (Table 78). Northern spicebush (*Lindera benzoin*) was the most common as a shrub, and mapleleaf viburnum (*Viburnum acerifolium*) was the most common in the seedling layer.

Table 78. Shrubs found in Rock Creek.

Latin Name	Common Name	Shrubs	Seedlings
¹ <i>Euonymus alatus</i>	burning bush	-	4
<i>Kalmia latifolia</i>	mountain laurel	1	-
<i>Lindera benzoin</i>	northern spicebush	53	34
¹ <i>Lonicera maackii</i>	Amur honeysuckle	1	5
<i>Viburnum acerifolium</i>	mapleleaf viburnum	-	38
¹ <i>Viburnum dilatatum</i>	linden arrowwood	1	1
¹ <i>Viburnum plicatum</i>	Japanese snowball	4	-
<i>Viburnum prunifolium</i>	blackhaw	-	5

¹Non-native species.

Forest Pests and Diseases

No targeted forest pests or diseases were found in Rock Creek.

Exotic Plant Species

Exotic Trees

Six exotic tree species (Table 76) were found in Rock Creek. They make up 4.8% of all individuals and 1.5% of all basal area in the tree layer, 9.8% of all individuals and 10.0% of all basal area in the sapling layer, but are absent from the seedling layer.

Vines in Trees

Over one third of trees had vines growing on them, though in few cases did they reach the tree crowns (Table 79).

Table 79. Presence of vines in Rock Creek.

Plot	Trees	Trees with Vines	Trees with Vines in Crown
ROCR-0027	22	3	1
ROCR-0045	24	2	1
ROCR-0055	16	5	2
ROCR-0079	27	21	8
ROCR-0121	18	7	1
ROCR-0145	30	-	-
ROCR-0180	29	22	2
Total	166	60	15

Most of the vines found in Rock Creek were exotic (Table 80) English ivy (*Hedera helix*) was the most common.

Table 80. Species of vines in trees in Rock Creek.

Latin Name	Common Name	Trees with Vines	Tree with vines in crown
¹ <i>Ampelopsis brevipedunculata</i>	porcelainberry	2	1
¹ <i>Celastrus orbiculatus</i>	Oriental bittersweet	8	7
¹ <i>Hedera helix</i>	English ivy	47	8
¹ <i>Lonicera japonica</i>	Japanese honeysuckle	2	-
<i>Smilax</i> spp.	greenbrier	1	1
<i>Toxicodendron radicans</i>	eastern poison ivy	7	-
<i>Vitis</i> spp.	grape	12	9

¹Non-native species.

Exotic Shrubs

Four species of exotic shrubs were found on the two plots (Table 78). These make up 10.0% of all shrubs and 19.8% of all seedlings found on the Rock Creek plots.

Exotic Herbaceous Plants

Six of the seven plots in Rock Creek had exotic herbaceous species (Table 81). The exception was plot ROCR-0145 in the Piney Branch section of the park.

Table 81. Presence of exotic herbaceous plants in Rock Creek.

Plot	Quadrats with Exotics	Number of Exotic Species
ROCR-0027	10	6
ROCR-0045	8	1
ROCR-0055	9	6
ROCR-0079	12	8
ROCR-0121	8	5
ROCR-0145	-	-
ROCR-0180	12	8
Total		14

Fourteen exotic herbaceous species were present, of which English ivy (*Hedera helix*) had the highest percent cover (Table 82).

Table 82. Cover of herbaceous exotic plants in Rock Creek.

Latin name	Common name	Plots	Mean % cover when present
<i>Alliaria petiolata</i>	garlic mustard	4	<1%
<i>Ampelopsis brevipedunculata</i>	porcelainberry	3	<1%
<i>Berberis thunbergii</i>	Japanese barberry	1	<1%
<i>Celastrus orbiculatus</i>	Oriental bittersweet	5	2%
<i>Duchesnea indica</i>	Indian strawberry	1	<1%
<i>Euonymus fortunei</i>	winter creeper	1	<1%
<i>Hedera helix</i>	English ivy	3	33%
<i>Lonicera japonica</i>	Japanese honeysuckle	5	1%
<i>Lonicera</i> spp.	honeysuckle	2	1%
<i>Polygonum caespitosum</i>	Oriental ladythumb	2	<1%
<i>Polygonum cuspidatum</i>	Japanese knotweed	1	6%
<i>Rosa multiflora</i>	multiflora rose	2	<1%
<i>Rubus phoenicolasius</i>	wineberry	3	1%
<i>Wisteria sinensis</i>	Chinese wisteria	1	1%

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Appendix A. Forest Pests and Diseases Targeted for Monitoring in 2008.

Pest or Disease	Scientific Name	Year Monitoring Began
Beech bark disease	<i>Nectria</i> spp.	2006
Butternut canker	<i>Sirococcus clavigignenti-juglandacearum</i>	2006
Dogwood anthracnose	<i>Discula</i> sp.	2008
Gypsy moth	<i>Lymantria dispar</i>	2006
Elongate hemlock scale	<i>Fiorinia externa</i>	2008
Hemlock wooly adelgid	<i>Adelges tsugae</i>	2006
Spruce budworm	<i>Choristoneura</i> spp.	2006
Other significant insect damage		2006

Appendix B. Woody Plants Monitored as Shrubs in 2008.

Latin Name	Common Name	Year added
<i>Alnus serrulata</i>	hazel alder	2008
<i>Castanea pumila</i>	chinkapin	2008
<i>Cornus amomum</i>	silky dogwood	2008
<i>Clethra</i> spp.	sweet pepper bush	2006
<i>Elaeagnus umbellata</i>	autumn olive	2006
<i>Euonymus alatus</i>	burning bush	2006
<i>Euonymus americanus</i>	strawberry bush	2007
<i>Euonymus atropurpureus</i>	wahoo	2007
<i>Gaylussacia frondosa</i>	blue huckleberry	2007
<i>Hamamelis virginiana</i>	American witch-hazel	2006
<i>Ilex verticillata</i>	common winterberry	2006
<i>Kalmia latifolia</i>	mountain laurel	2006
<i>Ligustrum obtusifolia</i>	border privet	2006
<i>Ligustrum ovalifolium</i>	California privet	2008
<i>Ligustrum vulgare</i>	European privet	2008
<i>Lindera benzoin</i>	northern spicebush	2006
<i>Lonicera maackii</i>	Amur honeysuckle	2006
<i>Lonicera morrowii</i>	Morrow's honeysuckle	2008
<i>Lyonia ligustrina</i>	maleberry	2007
<i>Rhododendron periclymenoides</i>	pinxter flower	2007
<i>Rhus copallina</i>	shining sumac	2008
<i>Rhus</i> spp.	sumac	2006
<i>Rosa carolina</i>	Carolina rose	2008
<i>Rubus argutus</i>	sawtooth blackberry	2007
<i>Sambucus canadensis</i>	American black elderberry	2008
<i>Sambucus pubens</i>	red elderberry	2007
<i>Staphylea trifolia</i>	American bladdernut	2006
<i>Symphoricarpos orbiculatus</i>	coralberry	2006
<i>Vaccinium corymbosum</i>	highbush blueberry	2006
<i>Vaccinium fuscum</i>	black highbush blueberry	2007
<i>Vaccinium stamineum</i>	deerberry	2006
<i>Viburnum acerifolium</i>	mapleleaf viburnum	2006
<i>Viburnum dentatum</i>	southern arrowwood	2006
<i>Viburnum dilatatum</i>	linden arrowwood	2008
<i>Viburnum plicatum</i>	Japanese snowball	2007
<i>Viburnum prunifolium</i>	blackhaw	2007
<i>Viburnum sieboldii</i>	Siebold's arrowwood	2007

Appendix C. Exotic Invasive Understory Plants Monitored in 2008.

Latin Name	Common Name	Year Added
<i>Akebia quinata</i>	chocolate vine	2006
<i>Alliaria petiolata</i>	garlic mustard	2006
<i>Ampelopsis brevipedunculata</i>	porcelainberry	2006
<i>Berberis thunbergii</i>	Japanese barberry	2006
<i>Celastrus orbiculatus</i>	oriental bittersweet	2006
<i>Centaurea biebersteinii</i>	spotted knapweed	2006
<i>Cirsium arvense</i>	Canada thistle	2006
<i>Clematis terniflora</i>	sweet autumn clematis	2006
<i>Duchesnea indica</i>	Indian strawberry	2006
<i>Euonymus fortunei</i>	winter creeper	2006
<i>Glechoma hederacea</i>	ground ivy	2006
<i>Hedera helix</i>	English ivy	2006
<i>Hemerocallis fulva</i>	orange day lily	2006
<i>Lespedeza cuneata</i>	Chinese lespedeza	2006
<i>Lonicera japonica</i>	Japanese honeysuckle	2006
<i>Lonicera</i> spp.	honeysuckle	2006
<i>Lysimachia nummularia</i>	creeping jenny	2008
<i>Microstegium vimineum</i>	Japanese stiltgrass	2006
<i>Polygonum caespitosum</i>	Oriental ladythumb	2008
<i>Polygonum cuspidatum</i>	Japanese knotweed	2006
<i>Polygonum perfoliatum</i>	mile-a-minute	2006
<i>Polygonum persicaria</i>	Asiatic tearthumb	2008
<i>Pueraria montana</i>	kudzu	2006
<i>Ranunculus ficaria</i>	fig buttercup	2006
<i>Rosa multiflora</i>	multiflora rose	2006
<i>Rubus phoenicolasius</i>	wineberry	2006
<i>Vinca minor</i>	common periwinkle	2006
<i>Wisteria sinensis</i>	Chinese wisteria	2006

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

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